PRACTICAL ENGINEER

Trade-mark, Reg. U. S. Pat. Off.

SEMI-MONTHLY

VOL. XVII CHICAGO, JULY 1, 1913 No. 13

LIGHT, HEAT AND POWER PLANT

Iowa Railway & Light Co. Employs Turbo Generators and Supplies Electricity to Several Small Towns

IT IS NOT UNCOMMON to transmit power by electricity many miles when the source of this power is a waterfall, but in Iowa we have a different situation which enables the Iowa Railway & Light Co., to transmit power from its central station in Boone to Perry, a distance of some 29 miles, and supply several other towns with the power they require at such a price that a generating plant would be impracticable in the smaller towns, owing to its limited capacity and hours of service.

which it supplies. In addition to this service, the plant furnishes heat to the business houses of Boone, thus utilizing the exhaust from its turbines to best advantage. The system of heating, however, is on the hot water plan, and will be described later.

Boiler Room

STEAM for driving the generating units of the plant is at present furnished by 3 Edge Moor water-tube boilers, space being allowed in the plant for 2 more of the same capacity. These are equipped with Foster superheaters and Illinois chain grates. The

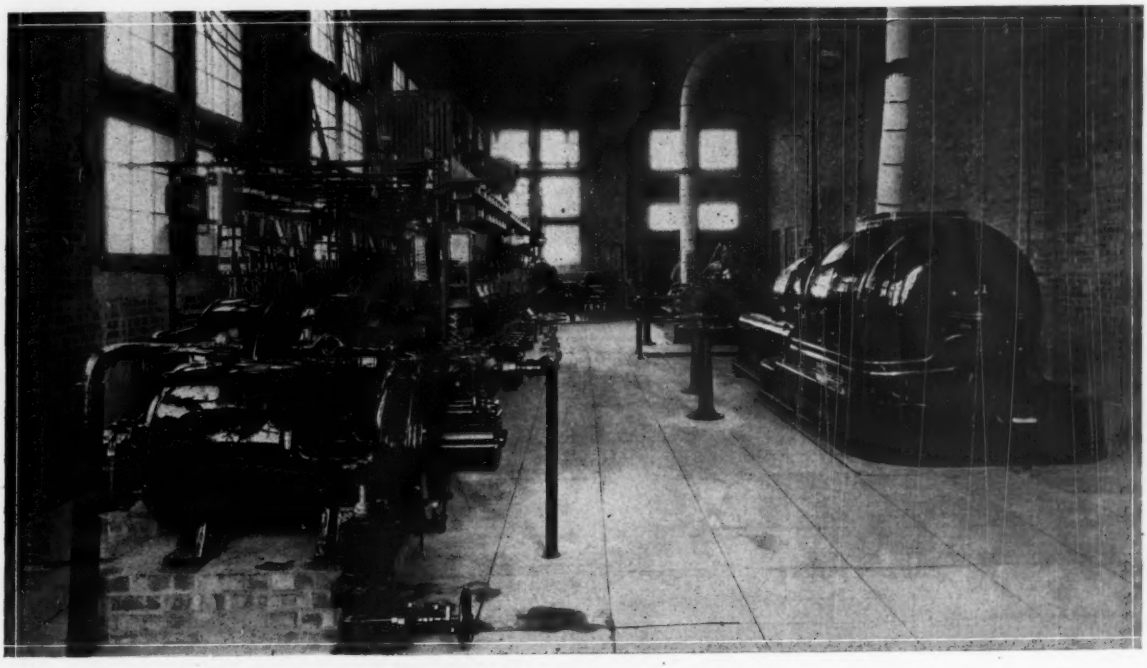


FIG. 3. GENERAL VIEW OF TURBINE ROOM

This plant furnishes power for the street railway system of Boone, also for several industries in the city, and all incandescent and street lights in the towns

capacity of each boiler is 400 hp., delivering steam at 175 lb. pressure and 120 deg. superheat. Ordinarily the stokers are driven by a motor connected by belt

to a shaft running along the front of the boilers, upon which eccentrics are mounted which drive the stokers through rods. For emergency purposes, a Wachs engine is provided for running the stokers.

The equipment of each boiler consists of an Ashcroft steam gage, Monarch safety water column, 2 Ashton safety valves, 2 blowoff lines, in each of which are placed an Edward Steam Specialty Co.'s angle blowoff valve, followed by an asbestos plug cock. Each boiler is equipped with a Vulcan soot blower.

There are 2 separate feed-water lines to supply water to the boilers, and in the one ordinarily used is a water meter. These lines are so arranged that water may be fed through either line. Steam from the

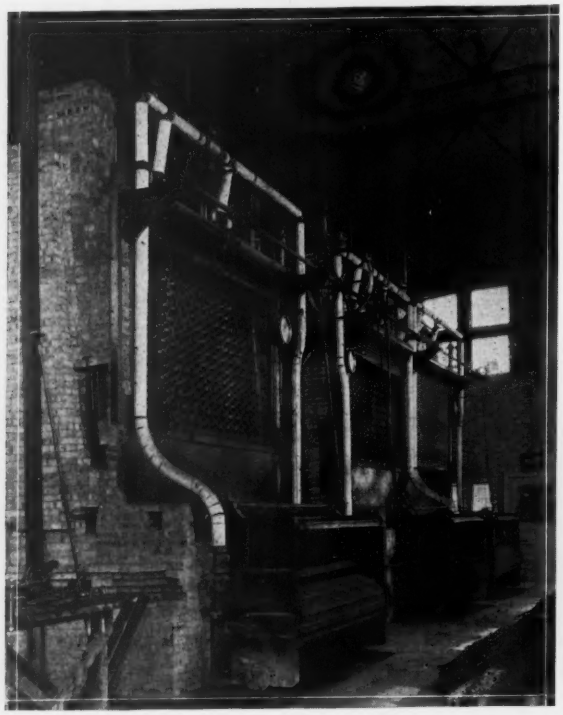


FIG. 1. EDGE MOOR BOILERS IN PLANT OF IOWA RAILWAY & LIGHT CO.

main units exhausts to surface condensers, so that no great amount of make-up water is required. The condensate, as well as make-up water, is delivered to a 1000-hp. Cochrane feed-water heater in the pump room.

Here, also, are located 2 boiler-feed pumps which draw the water from the heater through a manifold header, so arranged that it will take water from the heater or city mains, as desired. A boiler compound feeder is also attached to this header, by means of which boiler compound may be fed as required to keep the boilers free from scale. One of the boiler-feed pumps is a Canton-Hughes outside packed plunger, 10 by 7 by 12. The other is a Burnham of equal capacity, being of the simplex compound outside packed plunger type. These pumps are equipped with Fisher governors, which control the water fed to the boilers, and Hills-McCanna cylinder oil pumps. The fittings for the boiler-feed lines were made by the Crane Co. The water as delivered to the boilers ranges from 200 to 210 deg. F., this temperature being maintained by the Cochrane heater.

Steam used for heating the feed water is the exhaust from the boiler-feed pumps and the wet vacuum pumps, used in connection with the condensing system.

One of the natural advantages in this location of the power plant is the nearness of coal mines; the distance the fuel has to be carried being but a few miles, and the coal is delivered on a private side track in railway cars, from which it is shoveled to a space in the boiler room and thence fed by hand to the hoppers of the stokers.

Ashes are delivered from the ends of the chain grates to the ash pit, which is in the form of a hopper, and from this they are dumped into the company's own freight cars and hauled by electric locomotives out of the basement to the railway tracks.

Flue gases are conducted by a common breeching to a reinforced concrete stack, erected separate from the building, 185 ft. high and 10 ft. inside diameter, with a cleanout door at the base. The draft is regulated by a hand-operated damper in each boiler breeching.

Turbine Room

GENERATING units in the plant consist of 2 Allis-Chalmers turbines and one Buckeye engine. Each of these turbines has a capacity of 1000 kw., generating alternating current at 2300 volts, 252 amp., 3-phase, 60 cycles running at a speed of 3600 r.p.m.

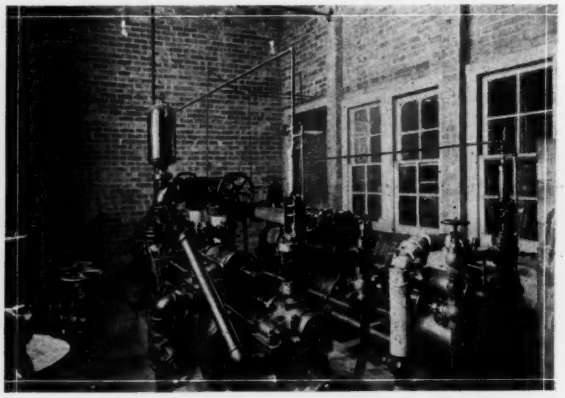


FIG. 2. BOILER-FEED PUMPS

Exhaust from the turbines is taken care of by Wheeler condensers. The reciprocating engine is cross-compounded and direct connected to a General Electric alternating-current generator, rated at 2080 or 2300 volts, 75 amp., 3-phase, 60-cycle, running at 200 r.p.m.

Excitation for all of these generators is furnished by 2 outfits, one being held as a reserve in case of accident or when starting up the plant. These are shown in Fig. 4, and consist of a Westinghouse motor-generator set, the driving member of which is a 61-hp. induction motor, wound for 2200 volts, 15 amp. per terminal, 3-phase, 60 cycles and runs at a speed of 840 r.p.m. The generator side of this set is rated at 40 kw., being wound for 125 volts, 320 amp., direct current.

The second exciter set is a 25-kw. General Electric horizontal turbine outfit. Voltage of the main generating units is under the control of a Tirrel regulator, which, of course, governs the output of the exciter sets.

Transmission and Control

CURRENT used for the commercial lighting system in Boone is distributed over the city at 2300 volts, and transformed to 110 to suit the customers' needs. These lines run directly from the power plant. The street arc lights are in series, and 2 series controllers, made by the Packard Electric Co., each rated at 25-kw., maintain a constant current of 6.6 amp. on the secondary, transforming the 2300 volts of the generators automatically as required.

Power used for operating the street railway system of Boone and suburbs is changed from alternating current, as generated, to direct current by an Allis-Chalmers rotary converter. The rating of the alternating-current side of this converter is 2200 volts, 89 amp., 3-phase, 60-cycle, running at 600 r.p.m., while the rating of the direct-current side is 550 volts at no load, 600 volts at full load, 500 amp., and 600 r.p.m. For starting this set, a direct-current motor is mounted on the shaft of the converter and run on the exciter circuit, being wound for 120 volts and 187 amp.

For controlling the output of the power plant, the switchboard, consisting of 14 panels, is located in the turbine room, and is shown quite clearly in Fig. 5. The panels which go to make up this board are as follows: One exciter panel; 3 for the generators; one for the recording instruments, which consist of a recording voltmeter, a recording wattmeter and an integrating wattmeter; one synchronous motor panel; 7 service panels and one direct-current service panel. Special equipment of this switchboard consists of a Tirrel regulator, shown most clearly in Fig. 4, a synchronous indicator and a 3-phase ground detector. Aside from the main switchboard is a separate panel for the arc lighting system, also shown in Fig. 5.

For keeping the electric apparatus free from dust, an air compressing outfit, made by the National Electric Co., has been installed which is driven by a 2-hp. motor, wound for 550 volts, 4 amp., and runs at 1350 r.p.m. The station gage board is placed in the chief engineer's office, and has mounted upon it a recording thermometer which shows the temperature of the water going to the heating system, a recording pressure gage showing the steam pressure on the

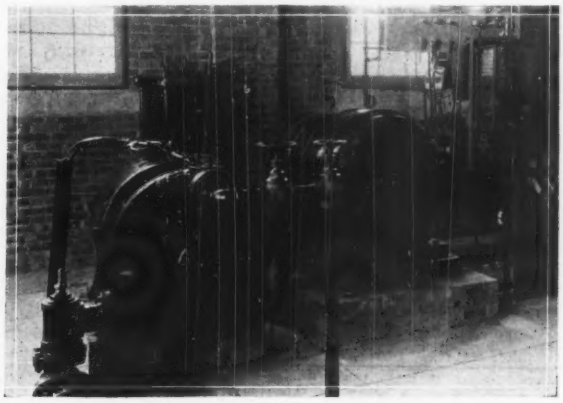


FIG. 4. EXCITING UNITS AND TIRREL REGULATOR

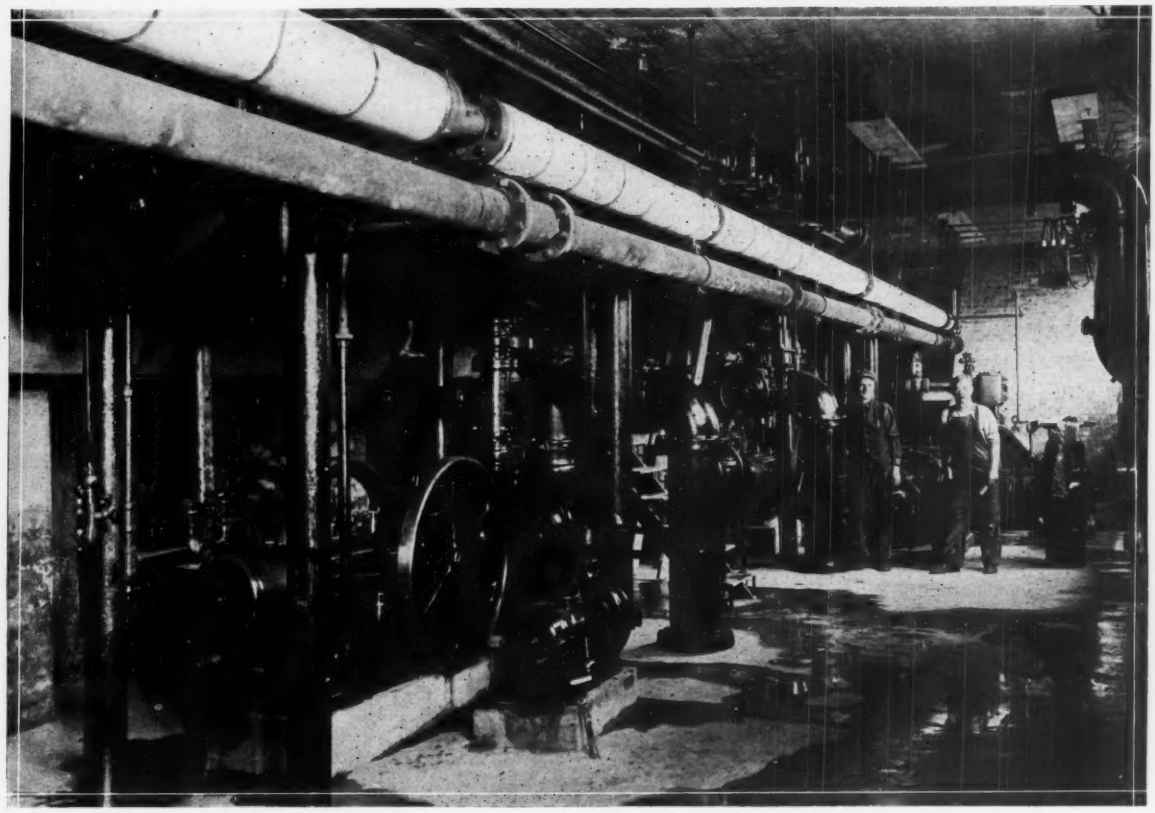


FIG. 6. VIEW IN BASEMENT SHOWING CONDENSING EQUIPMENT

turbines, both of these gages being made by the Bristol Co. Aside from these there is an Ashcroft steam pressure gage.

Condensing Equipment

DIRECTLY beneath each turbine is a Wheeler surface condenser; these are connected together in such a way that either can be used for condensing steam from either turbine or engine. One condensing set is connected with the central heating system, so that by running the condenser at a lower vacuum, the condensing water is discharged at a higher temperature than otherwise operated, and circulates through the heating mains. The vacuum is maintained in the condensers by a Wheeler rotary vacuum pump, and the condensation is delivered to the heater by a 2½-in. centrifugal lift pump, driven by a direct-connected, 2-hp. Allis-Chalmers induction motor.

The tubes in Wheeler condensers are arranged in small banks and baffles or rain plates are inserted between these banks so that the steam has free access to the tubes while the water of condensation is drained off at successive levels and allowed to descend to the hot well without coming in contact with the lower tubes.

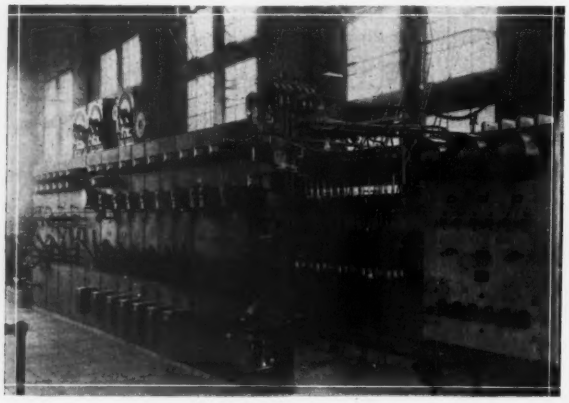


FIG. 5. MAIN SWITCHBOARD AND STREET LIGHTING PANEL

Two circulating water pumps are installed, one being a 10-in. Wheeler centrifugal motor-driven pump, and the other is of the same size, driven by a 9 by 9-in. Wheeler vertical engine. Condensing water is maintained at an inlet temperature of 60 to 90 deg., depending upon weather conditions, by a cooling tower 120 ft. long by 30 ft. wide and 20 ft. high, which is designed to care for 2000 hp.

District Heating

THE method of heating the city is known as the Evans exhaust hot water system. The vacuum is maintained at such a point as to give the outgoing water a temperature of 200 deg. F. The main pipe in this system makes a circuit through the business section of Boone, the farthest point being about 2 miles from the station. In all, there are some 70,000 sq. ft. of radiator surface supplied by the plant.

Circulation through the radiators of the buildings depends upon the difference in pressure in the main pipe between the inlet to and the outlet from the building; the inlet pipe being connected to the top of the main, while the outlet is connected at the side, thus the radiators and piping of a building form a shunt on the main piping. There are 2 centrifugal pumps provided in the power plant to force the water through the heating system. These are Evans Almirall pumps, belt driven from Allis-Chalmers induction motors, one of 60 and one of 30 hp., wound for 2200 volts, 14.8 amp., and run at 850 r.p.m.

Sub-Station

CURRENT that is transmitted at higher than generator voltage is stepped up by transformers, located in a sub-station nearby, separated entirely from other buildings. The principal transmission line leads to Perry, which is about 29 miles away, the transmission voltage being maintained at 33,000, and but one 3-phase line is employed. At the terminal is a sub-station containing 3 single-phase, 150 k.v.a. transformers, which deliver the current at the desired distributing voltage. The other towns furnished with power, Woodward, Madrid, Slater, Sheldahl and Luther, tap this main line for what power they need.

Another power line supplies current to a brick yard 5 miles distant, the voltage of the main line being raised to 13,000.

In the sub-station are 2 sets of transformers; that for the 13,000-volt line consisting of 3 Westinghouse single-phase transformers, each rated at 175 k.v.a, 60-cycles, transforming the voltage from 2300 to 13,500, and are connected in delta. To protect these transformers, 2 Westinghouse Type A electrolytic lightning arresters are connected up with a horn type spark gap and choke coils.

To step the voltage of the generators to 33,000, for the principal line, 3 Allis-Chalmers single-phase transformers are used, each of these having a rating of 175 k.v.a., and wound to transform from 2300 to 16,500 or 33,000 volts; these transformers also are connected in delta. The protecting appliances for this line consist of 4 Westinghouse electrolytic lightning arresters, suitable for 33,000 to 35,000 volts, connected up with horn type spark gaps and choke coils.

Another transmission line, which runs directly from the main station, carries current at 2300 volts to shops of the Chicago and Northwestern Railway Co., 2 miles distant.

In this plant, which has little more than 2000 hp. generating capacity, there is equipment that compares favorably with metropolitan central stations, and under the care of John May, chief engineer, is producing excellent service.

IN A RECENT article entitled Safety Rules, the vice-president of the Efficiency Society suggests for the engine room and other parts of a plant, the following:

All injuries, no matter how slight, should receive proper medical attention.

Never remove or even touch a safety flag or ticket. The man who places it should always remove it.

Safety committees may have overlooked something. See for yourself that everything is safe.

Take notice of all danger signs, and see that no one disregards them.

Safety devices must be maintained and be used as planned or they are of little value.

Careful men are usually efficient; careless men are not. Use safety devices always. Don't take a chance.

TO FACE A CAST-IRON pulley with leather, apply acetic acid to the face of the pulley with a brush, which will roughen it by rusting, and then when dry apply a cement made of 1 lb. fish glue and ½ lb. of common glue, melted in a mixture of alcohol and water. The leather should then be placed on the pulley and dried under pressure.

MEASURING STEAM CONSUMPTION

Method Employed for Running a Continuous Test of Steam Turbine

IN steam turbine driven stations it is essential in order that a gage as to the efficiency of a plant may be obtained to measure the amount of condensed water obtained from the turbine under the conditions of the load for which the test is being made, but in plants of large capacity it is not always an easy matter to measure this water in an accurate and continuous manner. The tank system, while good for medium powers, is apt to become rather bulky when large powers have to be dealt with; so that it is better, provided that it can be done accurately, to measure the quantity of water by weir or V notch measurement.

In order to do this, however, it is necessary to have extreme accuracy in the measurements, as a slight error can easily produce alarming results, and as an instance of the way in which this method of measurement has been carried out in a very complete and satisfactory manner, it may be interesting to refer to an installation at the Municipal Electricity Works at

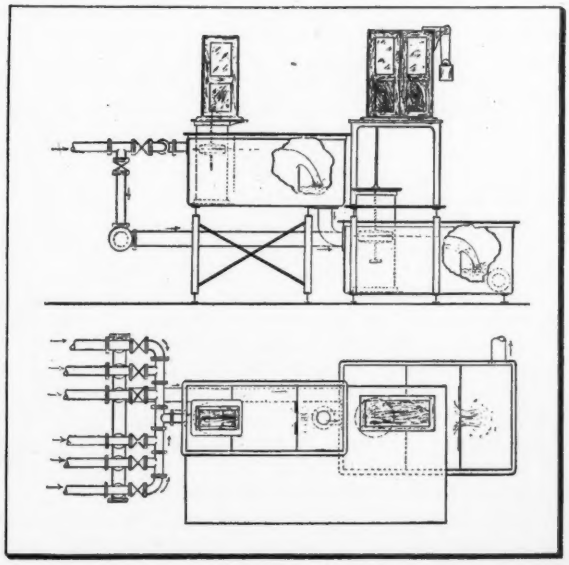


FIG. 1. METHOD OF CONNECTING RECORDING INSTRUMENTS

Wolverhampton in England. It is probable that a more complete installation for the purpose has not been hitherto fitted in a power plant.

This consists of 2 recording instruments made by the Lea Recorder Co., of Manchester, and connected as shown in the diagram in Fig. 1. It will be seen that 2 separate instruments are used, each with its own V notch tank, but the first is used as a test recorder while the second is the main recorder or integrator. The water from the tank belonging to the test recorder flows afterwards into the main recorder tank and thence to the discharge. Each condenser can be connected up to the apparatus by the pipe lines shown in the plan, while there is an inlet also from the water softener, allowing the make-up water for the boiler feed to be conducted either to the test tank or the main tank at will. In this way the boiler feed water can also be measured whenever required.

The test recorder is provided with 3 diagram clocks of different speeds. The first clock or disk revolves once in an hour, the second once in 4 hr., and the third once in 24 hr. The pen actuated by the float which in turn depends for its motion on the water level, thus records on one or other of the charts a

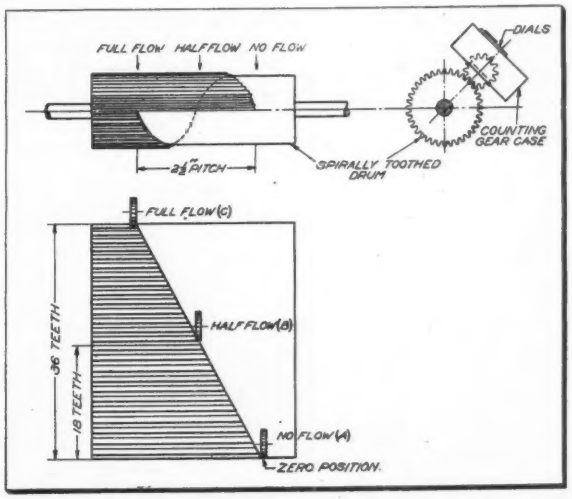


FIG. 2. MECHANISM OF INTEGRATING TYPE RECORDER

polar diagram which can be subsequently planimeted and the total water passing during the time of test can be determined. It will be seen that by using the quick running dial, very sensitive short time tests can be made and it is possible to conduct these without in any way interfering with the ordinary operations of

FIG. 3. APPARATUS FOR RECORDING STEAM CONSUMPTION OF TURBINES

the plant. In this way the behaviour of the plant can be studied under all conditions of loading with a great degree of accuracy.

The main recorder in series with the test recorder is of the integrating type. The mechanism which is used to obtain these integrations is of some interest and may be explained by reference to Fig. 2. The

counter gear is operated by a toothed spiral drum which is driven at a constant speed by a clock. This drum is moved to and fro on a slider bar in proportion to the height of water in the notch of the measuring tank. It will be seen that owing to the cut away portion of the teeth the gear wheel on the counters will engage a greater or less part of the time of one revolution according to the position of the drum on the slider bar and the setting is so made that when there is no water passing over the notch, the gear wheel just misses the teeth, while at full flow the gear wheel engages all the teeth. At intermediate heights it engages a greater or less number of teeth in proportion. In this way the integration on the counter gear varies absolutely as the variations of the water level.

Figure 3 shows the apparatus and its compact nature will be observed. The test recorder is shown to the left of the illustration in an open position, the main recorder being on the right, closed. The diagram on the latter provides an indication of the fluctuations of the load, and also the total load can be determined by a planimeter. The capacity of the main recorder is 100,000 lb. an hour, that of the test recorder being 40,000 lb. an hour, and in practice the equipment has proved of great benefit for the purpose of measuring and recording steam consumption.

SMALL COMMUNITY POWER STATION

By LeRoy W. Allison

ADVANTAGES and benefits, both pecuniary and otherwise, of municipal ownership in a small community, as primarily relates to water and electric supply and distribution, are particularly evident from the example set by Chatham, New Jersey, a borough of Morris County with a population of approximately 2000.

For slightly more than 15 yr. the municipality has enjoyed its own water plant, 11 of which have been in conjunction with a municipal electric lighting station. A brief review of the establishment of these plants exhibits the enterprise and energy of the borough, at the same time offering a noticeable basis for accomplishments for many small communities now similarly situated.

Previous to the inception of the public water plant in 1897, the water supply was one of individual ownership, each resident having his own source, usually a well or cistern on the premises. In April of the year mentioned, the council authorized a bond issue of $45,000 for the installation of a municipal water plant, and under the inspection of a formed board of water commissioners, the plant was completed and perfected in February, 1898. The Chatham driven wells are the source of supply; they are noted for their purity, and have such desirable location with regard to town layout that private water companies have acquired territory directly adjacent.

With the employment of oil lamps and the inadequate service attending, the question of proper lighting of streets and houses was agitated, until in October, 1901 the citizens authorized a bond issue of $15,000 for the construction of an electric-lighting plant. It was decided that this should be an addition to the water pumping station, providing for the installation of an engine, generator and auxiliaries in the new section of the plant, and operating both stations in unison.

The equipment of the plant, which has remained intact from the period of installing, comprises 2 horizontal tubular boilers, 80 hp. each; one 12 by 30-in., 125-hp. Hewes & Phillips Corliss engine, operating noncondensing and driving, at belt distance of 20 ft., a 75-kw., 60-cycle, single-phase, Fort Wayne generator. This latter operates at 600 r.p.m., and is accelerated by a 2-kw. exciter, Fort Wayne type. A 4-panel Italian marble switchboard is installed.

Pumping station consists of 2 Snow compound duplex pumping units, one 10 by 18 in. and 10 by 18 in., on steam and water ends, with capacity of 1,000,000 gal.; the other 7 by 12 in. and 8 by 12 in., on either cylinder end, with capacity of 500,000 gal. There is also installed a 6 by 8½ by 10-in. air pump for a small Wheeler condenser, and a 5¼ by 4¾ by 5-in. air pump for surplus in the suction system.

Boilers furnish steam to both engine and pumping units, which latter are operated for the most part at night, in order to effect the greatest possible economy; to maintain the required pressure, however, for the higher sections of the borough, it has lately become necessary to operate one of the pumps during the day. Water is pumped from a series of 5 artesian wells to a large standpipe, and thence distributed by gravity flow to all parts of the town.

The growth of the electric-lighting system has necessitated a constant overload during peak hours. The generator is alternated in running 24 hr. one day, and 23½ hr. the next, effecting a condition where it has become vitally necessary to augment the capacity, and eliminate risk of omission in service. The municipal electric distributing system is reduced to a minimum cost by provision in the borough franchise to the New York Telephone Co., permitting the use of the company's poles for electric light wires. The telephone company is also required to maintain the poles, and replace wherever occasioned.

In accord with the excessive demands now made upon the entire plant, the borough has recently voted bonds for $35,000 for its extension. The station will be remodeled, and further increased in efficiency by the installation of additional generating and pumping apparatus, allowing a large increase in capacity over present and near-future requirements.

The accompanying statistics of operation for a period of 12 months are interesting in showing the present economy of the entire plant and proportionate saving to the municipality. Reliable estimates of the cost of operation after the installation of new equipment, made by the Board of Water Commissioners, are incorporated, evidencing a further efficiency in the plant:

	Light	Water
Total Receipts	$8,773.01	$9,071.26
Total Expenditure,—maintenance, wages, fuel, interest on bonds, supplies and incidentals	9,148.94	5,189.20
Deficit	$ 375.93	
Profit		$3,873.06

Expenditure for extensions during year, paid for from earnings of plant and which are assets to the borough.....	978.83	2,304.53
Net Deficit	$1,354.76	
Net Profit		$1,568,53
Less Light Deficit.....		1,354.76
Net Profit from Plant.....		$ 213.77

The borough has fire protection and street-lighting free of cost, but if purchased elsewhere would cost as per statement below, and should therefore be added as a further profit accruing from the municipal plant:

104 Fire Hydrants at $20.00 each, fire purpose only	$2,080.00
190 Street-Lights at $17.00 each.....	3,230.00
36 Lights in Power House at $17.00 each...	612.00
Lighting municipal building, per meter readings	120.00
Net Profit	$6,042.00
Net Profit as above.....	213.77
Total Net Profit and Saving to borough for one year.....	$6,255.77

Cost of producing current at switchboard with present equipment at power house:

Labor	$2,190.00
Interest on bonds, 4 per cent.....	300.00
Depreciation, 5 per cent.....	400.00
Repairs and Supplies	182.50
Insurance	30.00
Fixed Charge Per Year.....	$3,102.50
Fuel	2,920.00
Total cost per year to maintain and operate light plant	$6,022.50
Electric energy delivered at switchboard in kilowatt-hours for year	182,500
Cost per kilowatt-hour	3.3 cents

Estimated cost of producing electric energy at switchboard with proposed new equipment at power house. (Cost includes maintenance and operation of water plant, also of present water and light plant):

Labor	$4,380.00
Interest on bonds, 4 per cent	1,950.00
Depreciation, 5 per cent	2,075.00
Repairs and Supplies	365.00
Insurance	100.00
Fixed Charge Per Year	$8,870.00
Fuel	2,920.00
Total cost per year to maintain and operate complete plant	$11,790.00

Electric energy delivered to switchboard per year for commercial use and street-lighting in kilowatt-hours, 201,115.

Estimated electric energy for pumping in kilowatt-hours, 163,885.

Total kilowatt-hours per year, 365,000.

Cost per kilowatt-hour, 3.23 cents.

Fifty per cent of the fixed charge item above is chargeable to the water department. Deducting this, actual cost applicable to the light department is:

Fixed Charge for Light Department	$4,435.00
Fuel	2,920.00
Total cost per year for producing 365,000 kilowatt-hours	$7,455.00

Cost of producing electric energy for commercial and street-lighting service, per kilowatt-hour, 2 cents.

Cost of pumping 250,000 gal. of water daily with steam-driven pumps as compared to cost of pumping the same quantity with motor-driven pump:

Steam Pump

Power required per 250,000 gal., 442 hp.-hr.	
Coal required per 250,000 gal., 2500 lb.	
Fixed charge per day	$ 9.36
Fuel charge per day	6.00
Total	$ 15.36
Fixed charge per year	3,407.50
Fuel cost per year	2,190.00
Total cost per year to pump 250,000 gallons daily	$5,597.50

Motor-driven Pump

Power required per 250,000 gal., 449 kw.-hr.

Cost per kilowatt-hour 3.23 cents.

Cost to pump 250,000 gal. daily, $14.50.

The above rate, 3.23 cents per kilowatt-hour, includes all fixed charges and operating expenses of entire plant.

Cost per year to pump 250,000 gal. daily, $5,292.50.

Saving effected over steam plant, 5.6 per cent.

The cost to pump the quatity of water noted, with above pumping unit and electric energy purchased at the rate of 3 cents per kilowatt-hour would be:

Power required per 250,000 gal., 449 kw.-hr.	
Cost per 250,000 gal. for electric energy, ...	$13.47
Fixed charge	9.65
Total cost per day	$23.12
Cost per year for electric energy	$4,916.55
Fixed charge per year	3,532.50
Total cost per year to pump 250,000 gal. daily	$8,449.05

Estimated saving by the borough generating its electric energy for pumping, 59 per cent.

Should the borough purchase the electric energy for pumping, it would still be compelled to retain its steam pumping plant for the purpose of having an auxiliary unit to provide for any omission in service, therefore a charge for maintenance of plant is included in the fixed charge items of above calculation.

IN SEARCHING FOR DEPOSITS of minerals, iron ore has been discovered in California in somewhat large deposits, one zone in the Eagle Mountain Range covering about 75,000,000 tons, extending from the surface several hundred feet down, and most of it of high grade.

No mining has been done, as there is no coking coal nearer than Colorado, but when the Alaskan coal fields are in operation, its coal will be shipped in large quantities to Pacific coast ports, making it possible to establish blast furnaces and steel plants.

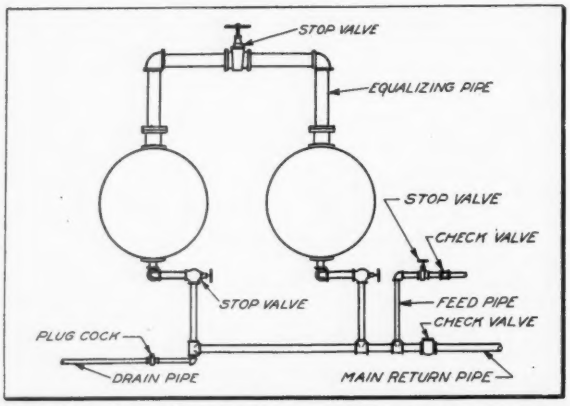
TO SPEAK WISELY may not always be easy, but to speak ill requires only silence.

LOW-PRESSURE HEATING BOILERS

Method of Operating to Insure Safety. Equalizing Water Level

WHEN starting a new fire, raise steam slowly, open the steam valves first and then return valves. In closing down a system, shut the return valves first, then the steam.

On coming into the boiler room in the morning, the first duty of the fireman should be to make sure that the water level in his boiler is right. This should be tested by the gage cocks as well as by the water level in the glass, as both gage glass connections and try-cocks sometimes become plugged with rust and sediment. Trying the gage cocks keeps the cocks flushed clean and detects any wrong level indicated by the glass. The gage glass should also be blown down by opening the water column connection. If the stop connection is plugged, the water will come back to a false high level, due to the condensation of steam trapped above the column of water. If the bottom connection is not free, the water does not rise in the glass at once after being blown down but accumulates slowly from the condensation of steam until it stands above the true water level and indeed will eventually fill the glass. It is a good plan to blow out the gage glass first to test its connections



RETURNS TO HEATING BOILERS WITH EQUALIZING PIPE AND PROPER VALVES

with the water column and then to blow down the column to test its connections with the boiler.

If plenty of water is found the fires may be brightened up or spread if banked and steam raised. When the boiler is steaming freely there is still another indication of plugged connections about the water column or gage glass which should be observed. If all is clear, the water level is never entirely quiet but surges slightly up and down, so that a perfectly motionless water line is a good indication that something is stopped up, and blowing out tests should be applied.

Safety Valve Test

TRY the safety valve cautiously while steam is being raised to make sure that it is free and operative. If found in good condition, it is advisable to open it under pressure occasionally to make sure that it is correctly set and steam should never be kept on a boiler whose safety valve cannot be raised by hand to test its freedom. In case the safety valve cannot be raised, the boiler should be immediately cooled, the fires first being deadened with wet ashes or fresh coal and then drawn, after which the cooling may proceed in accordance with the instructions given for boiler inspection. Under no circumstances should any attempts be made to repair the safety valve while there is any pressure remaining on the boiler as serious scalding is almost sure to result.

In case of water level below the glass or the lowest try-cock at any time, the fire should be smothered with wet ashes at once or if they are not available with fresh coal, the ash pit doors should be closed and the fire doors opened. Under no circumstances should water be fed to the boiler nor should the safety valve or any steam valve be touched. When the boiler is quite cold, an inspector should be called to determine the amount, if any, of the damage.

Damper Regulation

SEE that safety valve and damper regulator work at the proper pressures as indicated by the steam gage. If the damper regulator does not control the draft when the highest allowable pressure is reached, disconnect it from the damper and draft door. If it now operates freely, door or damper is sticking and should be cleaned or repaired so as to work more easily. If, however, the damper when relieved of its load refuses to work, or is sluggish, the chances are that the trouble will be found in a choked connection between the regulator and the boiler, or the regulator itself may need repairs. If gage, safety valve and regulator all work but do not agree in their pressure indication, they should be tested at once and the proper remedy applied.

Whenever leaks are discovered they should be located at once and repaired as soon as possible, but no repairs should ever be attempted until the boiler has been properly cooled off. In the case of any leak where there is the slightest doubt as to the safety of the boiler, an inspector should be called to determine the best course to pursue.

Equalizing

WHERE 2 or more boilers are operated together on a heating system, they should be provided with an equalizer to maintain a uniform water level so that one boiler cannot rob the others of the returning water of condensation. This equalizer is a large pipe connecting the steam spaces of the several boilers in the battery and is entirely separate from the steam supply header. It should not be used as a supply for any portion of the system. It should have as straight a run as possible, and should be provided with stop valves to cut off any boiler when necessary. Return pipes of the various boilers should be connected to a common return line with a stop valve for each boiler. A check valve should be placed in the return line on the building side of the branches to the boiler to prevent water flowing back to the radiators and the piping when the main steam valve is closed, but there should be no check valves in the branches to the boilers. The return pipe acts as an equalizer below the water line and should afford a free connection between boilers at all times. In case of one boiler of the group working alone on the system, the equalizer must be shut off, if the dead boilers are cut off from the steam and return lines. If, however, the dead boilers are still connected to the system, whether or not their fires are burning,

the equalizer must be opened to prevent the dead boiler from filling with water at the expense of the one which is working.

All surfaces exposed to the action of the fire or the products of combustion should be kept clean of all accumulations of soot and ashes by sweeping or other means.

Keep the Water Alkaline

TO prevent pitting or corrosion, which are especially active in some heating boilers, it is well to keep the boiler water alkaline at all times, which can be accomplished by adding a few pounds of dissolved soda ash at the beginning of the season. This will be enough unless the boiler is blown down and refilled before the end of the season, in which case the soda ash treatment should be again resorted to.

Morning Water Level

SUFFICIENT water in the morning does not necessarily mean just enough to show in the gage. When a large heating system is started in the morning, a great amount of condensation occurs in the cold pipes and radiators so that for a time the water level in the boiler will be steadily falling. All this water will eventually come back, but in the meantime the boiler may have been left for some little time with too little water in it. The engineer of the heating plant must experiment to determine how much water he needs in the boiler and should be sure that he has enough so that the morning draft of the steam will not take the water down below the bottom of his gage glass.—The Locomotive.

ESTIMATING FUEL REQUIRED

Notes and Formula to Determine Coal Required to Operate Steam and Hot Water Heating Systems

By J. P. Lisk

THE following work is intended to assist the heating contractor in making his calculations for the installation of a plant, when it is large enough to require coal handling apparatus, or, when the cost of temporary heating is covered in the specifications. The present method of specifying temporary heat, is to say, "the contractor shall include in his estimate a price to supply fuel and attendance to heat the building in a satisfactory manner when the outside temperature is at, or less than, 60 degrees Fahrenheit. This problem each bidder must work out according to his own judgment, depending on his past experience with a similar job. One pound of anthracite coal, of the average quality, burned at the usual rate of combustion in a boiler furnace for low pressure steam heating, and with the average degree of efficiency will yield 9600 B.t.u. to be delivered through the radiating surface within the rooms to be heated. This of course includes all losses in transmission through the piping system.

One square foot of direct radiating surface, maintaining a room temperature of 70 deg. F., when the outside temperature is at zero, will transmit 250 B.t.u. per hour, which is equal to 6000 B.t.u. per day of 24 hr.

With the wide variation in outside temperature, and the varying requirements for heat during a 24-hr. period in practically all classes of buildings except hospitals, the average B.t.u. transmission per square foot will not exceed 190, this multiplied by 24 gives 4560 B.t.u. for a 24-hr. period. Dividing 4560 by 9600 gives us 0.47+, or, in other words, one square foot of direct cast-iron radiation, with a steam pressure at 1 lb. above atmosphere, or, we may say, from a vacuum equivalent to 1 lb. below to 3 lb. above atmosphere, will require 0.47 lb. of coal for a 24-hr. period of operation.

When the radiating surface is wrought iron pipe coils, well arranged, the amount will be 0.62 + lb. And for indirect radiators, enclosed in casings, taking air from the outside and delivering through ducts and flues to the room to be heated, it will require 0.72 lb. per square foot. The above formula, or factors, are based on the assumption that the fuel contains at least 12,000 B.t.u. per pound and a steam generating plant and piping system of 75 per cent efficiency, consequently they would not give correct results if there was a wide departure from the assumption, therefore I have worked out the following formula, from data obtained under operating conditions in many plants, differing widely in detail, but designed to accomplish the same general results and recommend its use in solving the problems for which it was designed.

F = Square feet of radiating surface in the system.

W = Weight of water in pounds condensed by one square foot of radiating surface, for direct cast-iron 0.19, wrought iron pipe coil 0.25, indirect cast-iron extended surface type 0.29.

E = The efficiency of the heat generating and conveying system to transpose the B.t.u. in the fuel to the air and exposed surface of the room to be heated, = 75 per cent.

L = 0.001,035 a constant.

T = The hours in one day = 24.

H = The total heat units in one pound of the fuel to be used.

P = Pounds of fuel for 24 hr. operation.

Then $P = \frac{F\,W\,T}{L\,E\,H}$ or $P = \frac{F\,W\,24}{0.001{,}035 \times 0.75\,H}$

If a building is to be kept at 70 deg. during the entire 24-hr. period, and the outside weather conditions are very near zero, the factor W should be 0.24 for cast-iron direct surface, 0.32 for wrought iron pipe coils, and 0.38 for indirect, extended surface, cast-iron pattern radiators.

The reason for this change is found in the fact that the radiating surfaces are operating up to their maximum capacity. In using the formula the value of H may be obtained from tables prepared by various authorities, or, if the apparatus is at hand, by actual test of the fuel being used.

Likewise E may be determined by testing the boilers, if they are in service, or, if it is a proposed plant, the manufacturer of the boiler to be used will furnish a very close approximation of what his boiler will do when put in service. The other factors are not subject to any variation in value from that given.

The fuel requirement for hot-blast heating, and tempered air ventilation work, can not be determined directly from the heating surface employed, but rather by volume, and temperature rise of the air to be handled. The formula $P = \frac{V\,R\,C\,1440}{H\,E\,F}$ will give results

well within the range of everyday practice as it was derived from service conditions.

The symbols used in the formula are:

P = Pounds of fuel for each 24 hr. of operation.
V = Volume of air in cubic feet per minute passing through heater.
R = The temperature rise of the air in degrees F.
C = 0.000,020,4, a constant.
H = The total B.t.u. per pound, of the fuel used.
E = The efficiency of the entire apparatus used to transpose the heat in the fuel to the place to be heated.

For hot water heating, the formula becomes $P = \frac{FNT}{HE}$, in which the various symbols have the same value as in the previous formula. The factor N, has the following values: For direct heating, average conditions of service, as previously mentioned, 120. For the maximum condition, temperature 70 degrees throughout the 24 hr., and zero outside, 140. For indirect, average conditions, 160. For maximum conditions, 210.

In view of the fact that when information is wanted along the line of the matter above worked out, it is wanted very quickly, and, if the engineer, or heating contractor attempts to work out a long formula, his client will get the impression that he does not know his business as he ought; therefore, for convenience and quick work, I have arranged the table which assumes that the fuel to be used has a value of 9300 B.t.u., and that the apparatus is properly designed and installed, and will have the usual attention in its operation.

MULTIPLIERS FOR CALCULATING COAL CONSUMPTION

C I=Cast-iron Rods; P C=Pipe Coil			Average Condition		Maximum Condition	
			Steam	Water	Steam	Water
Direct	C. I	F. by	0.47	0.31	0.59	0.37
"	P. C	" "	0.62	0.34	0.79	0.41
Indirect	C. I	" "	0.72	0.42	0.94	0.54

For convenience in estimating the quantity in tons, it is a considerably shorter process to multiply pounds by 0.0005, than it is to divide by 2000, and of course the result obtained is the same. One ton of coal occupies approximately 40 cu. ft. of space. This figure is safe for estimating bins for coal storage.

The foregoing data furnishes an engineer with the means for making a comparison between a plant operating with exhaust steam from engines, and one operating on live steam direct from a boiler plant.

MISDIRECTED ENERGY

Lack of Experience Causes a Shut Down

By I. H. P.

AFTER a period of several weeks, our friend, the gas engine pessimist, found occasion one afternoon, to get off at P——— and wander over to the light plant to see how they liked their new engine. Leaving his grip at the hotel, he registered and said something to the proprietor to the effect that he supposed they had good lights now that the new engine was installed, to which the genial and urbane boniface replied that he guessed that they were having some trouble as the lights would go up and down, and down and up, and down and out for several nights, but he thought they must have got it running well at last, or were running the steam engine again, as the lights had been very steady the last 2 nights.

Smiling to himself he walked toward the plant and sure enough, on rounding the creamery corner, the tall stack with its sable plume of smoke trailing to leeward, and puff, puff, puff the exhaust greeted his surprised and delighted senses, and it was with difficulty that he suppressed his beaming countenance, before he entered the building, for he was a humane man and would not unnecessarily give anyone pain by seeming to gloat over others' troubles if it could be avoided. Oh, no! Far be it from such.

As soon as his eyes became accustomed to the change from the dazzling sun of out-doors to the semi-luminous interior, he noted that both rods had been taken off the pins and that a couple of men were industriously working on the pins.

Approaching the man nearest him he asked to see the manager, and when told he was out of town, asked several other simple questions about the weather and the apparatus, and receiving nothing but a gruff "yes," "no," and "I don't know," he concluded that he was making small headway, and soon decided to return in the evening and talk to the night man, with whom he had been favorably impressed on his last visit. Accordingly, at 8:30 p. m. he surprised the engineer explaining to his class of 3 students why locomotive cylinder centers are sometimes higher than the drive-wheel axle centers, in reply to a question which was put by an observing boy who had noticed it that same morning while going by the roundhouse.

Recognizing his caller, the engineer motioned him to a seat and accepted a cigar at the same time and with the same hand, saying he'd smoke it after dinner. After putting it carefully away he looked up in time to be offered another one and to hear the words, "That's all right, smoke this one, now." This old and time-worn bonmot produced a laugh and a feeling of good cheer prevailing, it was an easy matter to get the engineer started on the story of his past life, or "gas engine cussedness as she is spoken."

"Well, you see, it was like this," he began. "She started off and ran fine all the while the shopman was here, and we thought we knew gas engine from soup to nuts, had a complete set of instructions, verbal and printed, with a great many footnotes and afterthoughts on what to do, or what not to do in such and such a case, with a rule for everything and 8 exceptions to every rule. Everything was so simple and the producers so easy to handle. But the shopman had no sooner gone than she began to open up her bag of tricks. First, the magnetos began to miss fire, and we had to run on one side until our auxiliary dry cell and spark coil could be put in service; then later on we let the coal get too low in the producers, and the gas started to burn on top, which made the cast-iron tops so hot they cracked and let cold air in on the fires until we could plug them up.

Then, one day, it took 3 hours to start up on account of poor gas to begin with, then running the compressor so much gave us a great deal of moisture in our starting air, and shooting this moisture into the

cylinders got the spark plugs all wet and they had to be dried out. We've also been having a lot of trouble with the crankpins running warm. For a while we had premature ignitions which began regularly each evening soon after the peak hit us, and continued for 3 or 4 min., knocking the speed down 50 per cent, and then disappeared entirely, only to reappear the following night. This we think was caused by too much hydrogen in the gas, and we have partially corrected this by allowing most of the steam from the vaporizer to escape instead of carrying so much of it through the fires. We find also we've got to use good oil in the cylinders.

"Oh, as soon as we get onto the old girl's peculiarities we can begin to humor her and find out what she wants. We've learned fast, believe me. It ain't the engine's fault. We just don't understand, that's all. We'll get her to going yet as steady as any steam engine, or I'm a goat."

"What is the trouble now? said the visitor. "I came in today, and saw a couple of men filing the crank pins, and couldn't get anything out of them at all. In fact the heavy-set chap seemed quite grouchy."

"That was George, the day man, I guess. He's a great old kicker, all the time hollerin' about something. He'd kick if he was going to be hanged. He'd want to be shot." Then, after a pause, "Why, I'll tell you why she's down now. Yesterday, or no, it was Monday, day before yesterday, night, our window screen fell out of the window next the crank, and broke and as soon as the arcs were lighted inside that night, we had a fine collection of these nightbugs flying around. I didn't think much of it at the time, but I guess the suction of the piston and crank drew some of them into the collector ring that feeds the pins, and I didn't notice until the oil began running back out of the ring and then I jumped and felt of the crank and, great gas pipes! but she was hot. I shut off the gas on that side and swung the other side wide open thinking to ease up on her a bit, but the heavy load began to be too much for the other pin, and after fussing around with graphite and the hose awhile, I shut down.

"Now these crank boxes are bushed with a composition that melts at about 1800 deg. F., and naturally they didn't run worth a cent like good respectable babbit, but cut the pins a little. I've suggested to the boss a heavy wire mesh around the cranks and crank pit to keep foreign matter out, and it seems to strike him first rate."

"Then you still think the engine is all right, and will run as soon as you learn the ropes, eh?"

"Sure, Mike, she'll run, and run soon, too. Ain't she a dandy? Look at her. Don't she loom up? Some massive, eh? Look at that wheel."

"Yes, yes, I know, but right now, standing still don't get much dividends. She'd look good in a picture, but what the stock-holders want to see is moving-pictures."

And after making a few short jabs at that conversational punching-bag, the weather, the visitor wended his way hotel-ward, leaving another "two for a quarter" for his entertainer to smoke any time he saw fit.

(To be continued.)

HOWEVER VEXED you may be overnight, things will often look very different in the morning. If you have written a clever and conclusive, but scathing letter, keep it back till the next day, and it will very often never go at all.

—Lord Avebury.

PROVISIONS OF THE NEW JERSEY STATE LICENSE LAW

THIS law, which was passed this spring, provides for the appointment by the Commission of Labor of the State of New Jersey in his department, of a Bureau of Steam Engine and Boiler Operators' License, consisting of 3 persons, citizens of the state, and each of whom shall have been engaged at least 10 yr. as engineer in charge of a steam plant of not less than 250 hp., or as inspector for a steam engine and boiler insurance company, licensed to do business in New Jersey.

These examiners must be approved by the Civil Service Commission, and each is to hold office for 3 yr., except that of the first board, one shall hold office for 1 yr., one for 2 yr. and one for 3 yr. Vacancies in the bureau are to be filled by the Commissioner of Labor.

The 3 members of the bureau select one of their number as chairman, and have the power to adopt all necessary rules, regulations and by-laws for their government, and also for the examination and licensing of engineers and firemen in charge of stationary and portable steam boilers and engines; to fix the fees charged for issuance of licenses, and the terms and conditions of issuing and renewing licenses. All licenses recommended by the bureau are to be issued under the hand and seal of the Commissioner of Labor.

Exemptions from the necessity for holding license are persons in charge of or operating a steam boiler or engine under control of the United States Government, railroad locomotives, road vehicles, used in connection with the fire department of any municipality, and steam boilers for heating purposes only where the pressure is not more than 10 lb. per square inch. Also any person holding a United States Marine License is exempted from State License.

A plant may be operated in emergency not longer than 30 days by an engineer without license, provided the owner or agent of the plant notifies the Bureau in writing of such emergency.

Application for license must be made to the Bureau, giving the name, residence, age, color and nationality of the applicant, and his previous experience as engineer or fireman. The fee for examination and license is to be fixed by the Commissioner of Labor, but not more than $2.

License may be revoked for ignorance, neglect or intoxication while on duty, after notice to the holder of the license and a hearing before the License Bureau. If the license be revoked, the holder may appeal to the Commissioner for a rehearing before him, and his decision is final.

An engineer or fireman actually in charge of a boiler or engine when the act goes into effect, is not required to take examination, but may receive a license upon written request of the owner of the boiler or engine, or the owner's agent, to operate that particular boiler, engine or plant, provided application for such a license is made within 60 days after the Bureau has been organized.

Each member of the Bureau is to receive $1200 a year as salary, and all fees for licenses are paid into the State Treasury.

The law goes into effect on the first of July, and within 60 days all engineers must be operating under license obtained by examination or a special license for a given plant, as stated above.

Electrical Machinery and Appliances

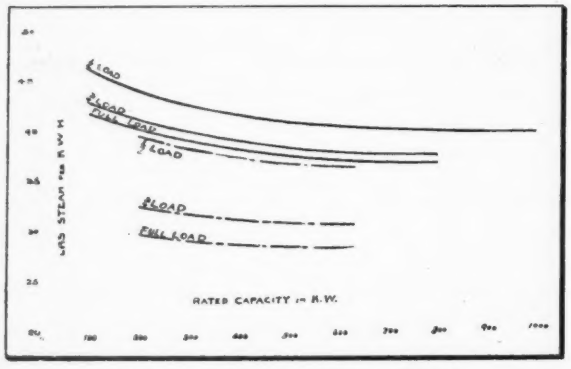
For Generating, Transmitting and Using Current

REPORT OF COMMITTEE ON PRIME MOVERS

Changes Embodied in a Report Made at the June 2-6, 1913, Meeting of the N. E. L. A. at Chicago

CHANGES are made from year to year in the various classes of prime movers, some of the most important recent changes being those briefly mentioned in this article.

In the newer water power plants there is a tendency to use vertical units, placing the thrust bearing on top of the generator, so as to support the entire revolving element with the shaft in tension. The bearing is thus accessible and the shaft diameter is decreased due to the absence of the compressive stresses. Single runners of high specific speed are used in place of multiple runners without materially affecting the cost of the plant. The principal materials for runners are cast iron, bronze, cast steel and plate steel cast into hubs of cast iron and bronze. Bronze seems to be



ECONOMY CURVES OF SMALL TURBINES

the favorite for general construction, provided the first cost is of minor importance. Its quality of resisting corrosion places it in preference to any of the other construction. For complicated forms and accurate curves it gives the best casting. Frequent pitting of the runners is due not so much to the fluid passing through the turbine and material used as to incorrect design of the runner. There are greater losses due to this than that of having the shell correctly designed with the runner incorrect.

Steam Turbines

AMONG steam driven prime movers, the most important under consideration is the steam turbine. The main points of change in the Curtis turbine are those of more stages and higher speeds. For vertical work, speeds of 720 and 750 r.p.m. are particularly well adapted. For the higher speeds of 1200, 1500 and 1800 r.p.m. horizontal machines must be used. Machines of 20,000 kw. are being built; designs for larger units have been completed. "All large machines are being equipped with removable nozzles and in most cases the diaphragms are split horizontally to permit ready removal." Efficiency is improved by use of superheat 150 to 200 deg. F.

Turbines for station auxiliary drives are being used in increasing numbers due to their advantages of compactness, general reliability and the availability of the exhaust steam for feed-water heating. Small turbines are being built by an increasing number of smaller manufacturing companies. The economy of these small turbines compares favorably with that of reciprocating engines, as is easily seen from the steam consumption curve shown in the diagram.

As the unit power of modern central station installations increases, the reciprocating engine is being discontinued; the low-pressure turbine thus becomes of lesser importance. "Manufacturers predict that in a short time the demand for this kind of apparatus will entirely cease."

Dr. Ferranti, the well-known pioneer in the various branches of the electric-lighting industry, is working on a steam turbine of more than laboratory proportions, having already constructed and operated a machine of 5000-hp. capacity, in which the superheated steam is to be maintained in a perfectly gaseous state in its travel through the turbine. "The steam is initially superheated, and while it is still superheated it is re-superheated before it does work in the second stage. The excess heat from the final exhaust, is reclaimed by a regenerator situated ahead of the condenser. It is reported that the results of many tests show that it will take less than 6 pounds steam per brake horsepower-hour, and that with a boiler plant efficiency of 85 per cent, as in the case of oil burning, the system will have a thermal efficiency of 24 per cent under its designed condition.

The Locomobile

IN regard to high-efficiency self-contained reciprocating engines of the Stumpf, Wolf Lenz, Locomobile and Menning types but little progress has been made in this country. Most manufacturers after careful and costly investigations have decided that such types are as yet unprofitable. While the economy of the engine compares favorably with that of the cross-compound, the expense of building and maintaining it is greater. The turning moment is not so uniform. Various items of general interest on power plant operation might here be mentioned.

A steam blower, in one plant, has been so piped and connected that it draws air and the fine coal dust from a sump in the fine coal pit, thus effectually cleaning the latter and discharging the dust as fuel over the furnace.

As regards flow-meter usage in the boiler room it seems to be the prevailing opinion that the instrument is of considerable value. It is necessary for accurate indications of the meter that the fluctuations of the water-level in the boiler be reduced as much as possible. Quite frequently the feed-water regulators are to blame in not being correctly connected up or in their inability to respond to slight difference of water level.

Steel Stacks

GENERAL opinion in regard to self-sustaining steel stacks seems to be that it is not only necessary to prevent corrosion and deterioration of the stacks on the outside, but that it is even more necessary to provide for internal preservation of the stack. It is recommended that the stack be lined throughout with bricks and that the grouting be carried to the metal so that none of the metal is exposed to the gases. Stacks protected in this way have given good satisfaction, some having been in service for 20 yr.

The value of CO_2 observations and determinations seems to be regarded as of lesser importance than a good steam flow meter. Samples of gas are frequently unreliable in that they are not correctly taken. "Samples should be taken as nearly as possible at the point where the gases leave the heating surfaces, and in all cases near the center of the moving gas currents." Wide variations in the readings can be obtained if the work is not done correctly.

The air supply for boiler rooms in cold weather seems to be a subject, the importance of which is much underestimated. The usual practice seems to be to close off all sources of air. The rate of burning fuel must evidently be lowered. It is a common experience about boiler rooms, in cold weather, to encounter an inward rush of air on opening an outside door to such an extent, very often, that one is prompted to grab his hat and button up the coat, much as would be done in a wind storm. Certainly such a draft is a good indication of the necessity for more air supply. "Tests were made in 3 large boiler houses in which there was found a difference in pressure between inside and outside air of 0.07, 0.1, and 0.16 in. of water respectively." Improvement can certainly be made in this direction.

The V-notch weir method of feed-water measurement is recommended for the simplicity of its construction and the accuracy of its readings at all times. The angles may be less than 90 deg. without impairing the efficiency and thus enabling it to be used for very small quantities of water.

The Venturi meter and the General Electric water-flow meter are highly spoken of. Their installation is usually a simple matter, especially if the plant is previously laid out with such installations in mind.

The use of steam atomizers for oil fuel in boilers is receiving increased interest in that their operation is now possible on from 1 to 2 per cent of the steam generated by the boiler which they serve. "The capacity of a good steam atomizing burner is placed at about 400 boiler hp. and it is possible with such burners to operate a boiler at from 200 to 450 per cent of rating."

The market for gas engines and producers appears to have been unusually quiet the last twelve months. This may be partly accounted for by the great trend toward centralization of power and the call for units of large capacity. "The high-powered gas-engine installation seems to be financially uneconomical as compared to the large units of steam turbines."

The existing internal-combustion engines give satisfaction for small power plant requirements. But the rapid increase in weight and size of reciprocating parts with the increase in power is one of the main disadvantages and objections to their use in large installations of 20,000 kw. as is easily attained in the steam turbine.

"The heavy oil engine of the Diesel type continues to develop and its extensive adoption for marine service seems particularly probable within the next few years." The smaller sizes in a greater number seem to have the preference due to the economy of the small sizes, being as great as that of the larger and, on the other hand, considerable trouble being experienced in the manufacture and maintenance of the larger sizes. "It is estimated that the general maintenance of a heavy oil engine installation is about 50 per cent higher than that of a steam plant of like capacity." The principal advantages are certainly worthy of consideration; among the main points might be mentioned the saving of fuel cost, the economy in space and handling of fuel and the short time required to start the engine.

The Humphrey pump is exceeding expectations and contract stipulations in some of the more recent installations. To supply the Chingford reservoir, one pump of 7 ft. diameter combustion chamber and 9 estimated cycles per minute was rated at 40,000,000 gal. per day. The operation, however, showed a discharge of 50,000,000 gal. per day, the lift being 20 to 30 ft. The fuel consumption was under the guaranteed amount, that of not exceeding 1.1 lb. of anthracite per actual pump hp.-hr.

PRESERVING POLES AND POSTS

IN discussing the question of preservation of poles, the committee of the National Electric Light Ass'n. gave the following facts in regard to brush treatment with some preservative, preferably creosote oil. It is conceded that the part of the pole most likely to decay is just below and just above the ground line so that this is the part selected for treatment. The pole should, therefore, be painted about 2 ft. below and 2 ft. above where the ground line will come, or generally over a section between 4 and 8 ft. from the butt. Only seasoned poles should be treated, and care should be taken to see that the wood is thoroughly dry before the treatment is applied.

It is preferable that the creosote oil should be heated to a temperature of 150 to 175 deg. F. and much better results are obtained from two coats rather than one. Particular attention should be paid to filling all checks and knot holes, and working the preservative well into the wood. An average 30-ft. pole will absorb by this treatment about 4 lb. of oil, or ½ gal., and when treated under proper conditions a penetration of 1/16 to ⅛ in. into the wood can be secured. This method of treating can be applied easily in any locality and it has been found that when treating a large number of poles this can be done at a cost of approximately 25c a pole for oil and labor. It was estimated that such treatment increases the life from 2 to 3 yr., but results seem to indicate that the increased life will be more nearly from 4 to 5 yr.

In what is known as the open tank treatment, which consists of placing the butt end of the pole in a tank filled with an antiseptic preservative, such as dead oil of coal tar, the preservative coming up for a distance of about 8 ft. from the butt end or a point about 2 ft. above the ground line, the oil is heated to

a temperature above the boiling point of water. This high temperature should be maintained until bubbles cease to appear on the surface of the oil, which indicates that the air in the wood has expanded and the water in the outer layers has been driven out. The oil should then be permitted to cool or the poles transferred to another tank containing cold oil.

The partial vacuum thus produced by contraction of the air will draw the oil into the wood. A treatment by this method takes about 24 hours, the pole being in the oil some 8 to 9 hr. and the penetration obtained is from 2 to 4 times that by the brush treatment. The mere dipping of the poles into the tank of oil, without the heating and long soaking, is not much better than the brush method. Tests show that an average 30-ft. pole of northern cedar will absorb about 48 lb. or 6 gal. of creosote oil in the open tank treatment, western cedar about a gallon less, and chestnut about half as much as the northern cedar. The cost for a 30-ft. chestnut pole will be about 75c, and for the cedar pole about $1, on account of the greater amount of oil absorbed.

APPROXIMATE COST OF BUILDING WIRING

Average Figures Suitable for Estimating the Cost of Doing Work on Buildings Already Erected

THESE figures were prepared by a committee of the National Electric Light Association, for the guidance of its members in making estimates on the cost of wiring old buildings and are, of course, subject to variation with labor cost and the market price of materials, but they will serve well as an index for engineers to whom the question of doing wiring in house or factory is referred.

The costs are based on labor figures of $4 a day for wiremen and $2 a day for helpers and an addition of 30 per cent on the cost of labor and materials, is made, as indicated at various points, for the purpose of covering overhead charges of conducting a business of wiring. The figures do not include any profit on the work.

Service Connection

THE first proposition taken up is that of making connections from the lines to the house, and it is assumed that if an extra pole is needed on account of the depth of the lot the cost will be about as follows: Pole, cross-arms and pins and copper wire for a second span, $12; labor $8 or a total of $20, which, with 30 per cent added for general expense, gives about $26 for a pole and a single span.

If the wire must be put underground, the cost of labor for a trench 2 ft. deep in earth runs from 20 to 25 cents a foot, and the cost of material for 3 No. 6 wires and a fiber pipe laid in cement runs from 44 to 61 cents a foot. The committee suggests a figure of $1.10 a foot including general expense for such construction.

Where service pipe must be run down the side of the building from overhead service, for ¾-in. galvanized pipe, and 2 No. 8 rubber covered wires, the labor cost would run from $1.50 to $2 and for 20 ft. of pipe, 50 ft. of rubber covered, double braided solid wire, 2 condulets, clips and bolts, the cost of material would run about $3. Total labor and material cost with general expense added would then run about $6, and for a length of pipe above 20 ft. the cost would run about 30 cents a foot.

Where a ground wire has to be installed, the figures were 10 cents a foot for labor and about the same amount for material with an average run of 15 ft. of wire, making a net cost, including general expense of 26 cents a foot or a total of about $4 for a 15-ft. run.

For a service switch, the labor cost was estimated at about $1, the material at $1.15 for ordinary grade of switch, giving a net cost of about $2.25 including the general expense allowance.

Where a run is necessary from the service switch to the center of distribution or panel box, metallic conduit is to be used in the basement, and from the basement up to the center of distribution either flexible metallic conduit or armored cable. On the basis of running 40 ft., the labor cost was fixed at $2.75, and the material cost at $6 or a total with general expense of $11.60. In case of small houses, very likely this run to the center of distribution would not be required.

The cost for meter board was averaged at 20 cents for labor and 25 cents for material or a net cost of 50 to 55 cents including the general expense. This would give a total cost, adding the various charges for run up to the center of distribution, of $24.25, which would be independent of the number of lamps, except in a case where there are very few lamps, and the distribution box is placed directly at the service switch, in which case the cost would be $12.75, or allowing for some extra work, about $13.

In case a 3-wire service is required, an extra length of wire would be required in the service pipe, and probably a larger pipe down the side of the building. Also, probably the run from the service entrance to the center of distribution would be larger, involving an added cost of say $18 for the extra third wire.

Cost per Outlet

THREE styles of wiring are considered, the method being to determine first the cost of a standard ceiling outlet, each outlet carrying its proportion of the cost of cutout box and fuse, cost of loop to the outlet, the outlet box in case of concealed work or the rosette in case of open work, the total making the cost per outlet, whether a switch is used or a lamp. The costs of a ceiling outlet are given for the various kinds of wiring, and for other styles of outlet, such as wall and floor, percentage difference is figured between these and the standard ceiling outlet, the assumption being that the percentage difference is about the same whatever the kind of wiring used.

For open wiring the labor cost was 60 cents and the material cost 75 cents, or a total of $1.75 per outlet including general expense. With wooden moulding, the labor estimates averaged 75 cents and the material estimates 85 cents giving a total cost of $2.60 including the general expense. With concealed knob and tube work, involving some flexible, non-metallic conduit, labor cost was $1.50, and material cost $1.50, or a total of $3.90 including the general expense. For metallic moulding the average of labor cost was $1.50 and material cost $1.75, or a total of $4.23 including general expense. Where armored cable is used, labor cost was averaged at $1.75, and material at $2, or $4.87 total including general ex-

pense. For flexible metallic conduit, the labor average was $2, and the material average $2, or after adding general expense a total of $5.20. This gives us the standard ceiling outlet cost, from which, by percentages, are obtained the wall outlet and base-board outlet costs.

The general opinion was that an average wall outlet cost would be about 5 per cent more than a ceiling outlet, but the committee agreed that, on the basis that the proportion of wall to ceiling outlets would be fairly uniform, it would be safe to make the price for wall outlets the same as for ceiling outlets, and the same argument was applied in the case of base-board outlets. It is possible always that local conditions and the employment of a carpenter to cut the openings may increase the base-board outlet cost, and this should always be carefully considered.

For floor outlets, the opinion was that the cost should be about the same as for a ceiling outlet, but it was also the opinion that an outlet in an upstairs room would cost more than in a downstairs room.

Switch Outlet

SWITCH outlets were figured to be a little more expensive than ceiling outlets, but the general opinion was that for the wiring alone the cost might be figured the same as for a ceiling outlet without serious error. For a double-pole switch the cost would be considerably more than for a single-pole switch, and an addition of 30 per cent could be made for such a switch as compared with the ceiling outlet. For a ceiling switch to be placed near the door where often no extra wiring would be required, it was figured that the outlet could be wired for about 30 per cent that of a standard ceiling outlet. When a 3-way switch is desired, the general opinion was that the cost would be about 320 per cent of the cost of a standard ceiling outlet, and if a 4-way switch is needed in addition to a pair of 3-way switches, 50 per cent should be added to the cost of the 3-way switches for each 4-way switch furnished. This depends, however, on the location of the 4-way switch; if the additional point comes between the first 2, the extra cost will be slight, but at a distance the extra cost will be considerably greater than estimated.

For electrolier switches, a 2-point switch was considered to cost about the same as a double-pole switch, or 130 per cent of a standard ceiling outlet, and a 3-point electrolier switch would cost about 25 per cent more than a 2-point.

Heating Circuit

IN the matter of heating devices, it was recommended that a special circuit should be installed with No. 12 wire and the cost per outlet would be 145 to 220 per cent of the single outlet on an ordinary circuit, the general opinion being that the average would be about 200 per cent of the standard ceiling outlet cost. An automatic door switch outlet would cost about 130 per cent of the standard ceiling outlet cost.

Cutting Floors

IN wiring old buildings, it is frequently necessary to cut hardwood floors in order to lay the wires underneath, and the estimate of cost for this item varies widely, depending on the method employed. Where a special man can be used for this work, he becomes skillful and can do it at low cost, but with average conditions the general opinion was that a charge of $2.50 for labor or $3.25 with general expense included should be made for each cut.

Where an outlet is called for in a brick wall not furred, so that the wall has to be channeled, the labor cost was estimated on the average at $2.50 or a total of $3.25 including general expense. Where 2 or more switch outlets or a receptacle and switch come out at the same point an allowance of 65 cents for cost may be made.

The above figures are all for the labor of installing the wiring up to the outlet, and for installing the various switches, receptacles, etc., the labor cost was figured at 25 cents each including the general expense, but for a door switch, or bell ringing transformer the cost would be considerably greater. Running wires from a bell ringing transformer to a door lamp, the cost was figured at $2, or, including general expense, a charge of $2.60. It was suggested that, in addition to the cost as figured from outlet on the above basis, an extra charge of $1 a room should be made to take care of different characteristics of houses, and the costs as given made somewhat less in order not to have the total amount run too large.

The committee suggested that if a price list is used for estimating with customers, the costs above should be doubled and a discount made from the list according to circumstances. The list is intended merely to help in a quick, rough, but reasonably accurate estimate of the cost of the job, and for the first few times it is used should be checked by the ordinary method of making a contractor's estimate to see how closely the figures correspond with local conditions. The figures do not, of course, include any cost for switches, fixtures or installing them.

General Rules

CERTAIN rules were also laid down as follows: Hardwood floors do not add to the expense of wiring, unless the wires must be concealed beneath the floor; and hardwood borders do not count, unless they extend more than 3 ft. from the walls. Receptacles for heating should be for 20 amperes and a pilot light should be installed on the circuit. Each outlet or ordinary receptacle is figured to carry 40 watts. All work and material are to be in accordance with the National Electrical Code, and the rules of the city or town where the job is installed.

While the minimum size of wire to be used in lighting systems is No. 14, the committee believes that for many installations No. 12 should be the minimum size. It believes also that for residences each lamp socket and each receptacle for small devices should be estimated at a uniform wattage and that the rule providing for a maximum size of fuse for 6 amp. on a branch circuit ought to be changed to allow 10 amp. on circuits of No. 14 wire and 15-amp. fuse on No. 12 wire.

It is believed also that small portable devices, such as chafing dishes should be used from the receptacle for small devices rather than from a fixture or wall bracket, and that receptacles for such devices should be allowed on lamp circuits without special penalty. These receptacles rank the same as lamp sockets in household installations. It was recommended also that for large current consuming devices, plugs should be provided which will not fit into receptacles for small devices or ordinary lamp sockets, and that such plugs should be marked not suitable for use on lamp circuits. It was recommended that the dividing line between the large and small device should be about 6 amperes, and any device which takes over 660 watts should not be permitted on a lamp circuit.

BOILER EXPLOSION ON STEAM BARGE "E. M. PECK" AT RACINE, WIS.

By Geo. H. Wallace

THE worst disaster in the history of the city of Racine, and one of the very worst in the history of both the State of Wisconsin, and navigation on the Great Lakes, took place at 10:35 on the morning of June 11, 1913, when a Scotch boiler, one of two, on board the Steam Barge, "E. M. Peck," exploded as she was backing away from the dock in the river, killing the chief engineer, first and second assistant, and an oiler instantly, injuring 3 more fatally who have since died, besides wounding more or less seriously, many of the crew of the "Peck", and doing damage conservatively estimated at from $50,000 to $60,000.

The boiler was 11 ft. long overall, and 132 in. in diameter according to the certificate of inspection which hung in the cabin of the boat. Together with the vessel, it was built in 1888 and has been in operation since, during the season of navigation, being laid up in winter.

The shell was originally made of 7/8-in. steel, in 2 sections, each of which was made up of 3 sheets, riveted together with a triple riveted butt double strap joint, in which the 1-in. rivets were pitched 3½ in. apart horizontally, and 2½ in. diagonally.

The heads were riveted to the shell, and the 2 sections of the latter were riveted together with double riveting, the rivets being 7/8-in. and pitched 3½-in. circumferentially, and 2½-in. diagonally.

The front head was 11/16-in. thick and made of 3 sections, the lower of which contained the 2 furnaces and each of the upper sections, the tubes of each furnace. The back head was also of the same thickness as were the sheets comprising the combustion chamber, the boiler being of the usual water-back type common to marine practice.

The outside back head was made up of 2 sheets, 13/16-in. thick, double riveted together with the seam horizontally, and stayed to the combustion chamber with 1⅛-in. staybolts, a majority of them being solid with a few, usually in groups, of the safety type, being drilled at the end, with a quarter inch hole deeper than the thickness of the sheets. There were

FIG. 1. VIEW FROM DEMOLISHED DECK HOUSE INTO HOLD SHOWING GOOD BOILER AND ENGINES

no drilled holes in the sheets, all being punched.

Above the combustion chamber, tying the 2 outside heads together were 22 through bolts with double nuts and washers at each end, the bolts being 2 in. in diameter both in the rod and at the base of the thread.

Below the furnace were 6 through stays, 9/16 by 3 in., extending from head to head and attached to them by riveting 2 heavy angle irons to the heads, holding the end of the bar in place with a 1⅛-in. machine bolt passing through the angles, and through a hole punched in the end of the stay.

For the most part, the stay bolts were pitched in rows, 4½ by 5 in. apart, with an occasional bolt of a larger size, as if to cover up a defect in tapping the hole for the regular size bolt. Threads on staybolts were 10 threads to the inch.

There were also several short braces of the crowfoot type with one end riveted to the shell, and the forked end pinned to a section of T iron riveted to the shell. Many of the forks ruptured in the weld.

The boiler contained 128 tubes, (64 for each furnace,) each 3½-in. in diameter and 8 ft. long. To support the crown sheets, there were numerous crown bars, double, ⅝ by 4 in. welded together in pairs. Owing to the completeness of the rupture of the boiler as a whole, it is impossible to tell just how many of these crown bars there were originally, as only 5 were found in place, the remainder being found amid

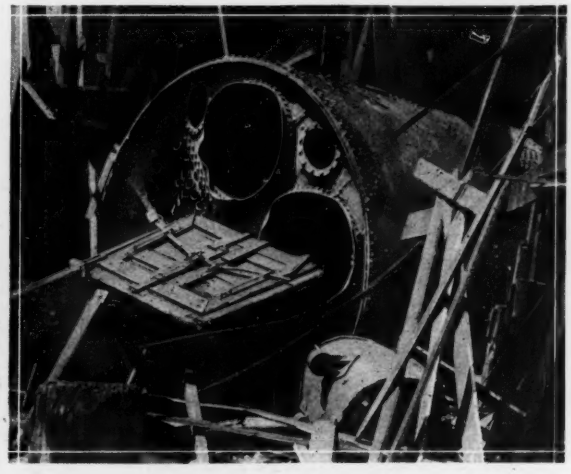


FIG. 2. CLOSE VIEW OF BOILER AS IT LANDED IN COAL SHED
Photo furnished by E. T. Billings.

the wreck and in the cargo of coal all the way from the stern to well forward of the deck house which was completely demolished as seen in the foreground of Fig. 1.

Furnaces were of the Adamson type of 4 sections of ⅜-in. steel, double riveted at both the flanges and the horizontal seams. Both furnaces had been patched on the bottom some time in their career as is shown in one of the illustrations.

Figure 2, which shows the boiler where it landed in a coal shed, shows plainly the manner of reinforcing the manholes in the front head, of which there were 3. There was also one in the top of the forward section of the shell. The latter manhole, however, was reinforced by an additional section of shell plate being riveted on circumferentially.

There were no manholes or handholes in the back head, although there were 2 handholes in the back head of the boiler which remained in the boat, and which did not explode. There was, however, a 2-in. pipe connection from which the pipe had been stripped.

The "E. M. Peck" had made Racine for many years with coal for the local dealers, and was of a little over 1800 tons gross burden, about 1500 tons net. She was 265 ft. long and 40 ft. beam. On April 25 of the present year, she was inspected while on her first trip of the season, while unloading coal at this port.

FIG. 3. SIDE OF VESSEL RIPPED OPEN TO WATER LINE
Photo furnished by E. T. Billings.

On this occasion, she arrived in port June 9, and on Monday, June 10, unloaded a part of the cargo at the lower yards of W. H. Pugh to whom it was consigned. Tuesday morning, about 10 o'clock, the breaking of the unloading apparatus at the lower yard necessitated taking the boat to the upper yard, a matter of about 450 yd., to discharge the rest of the cargo.

The boat got under way, with the mate in command and Chief Engineer Wm. Andrews at the throttle, first Assistant Engineer Swensen and Oiler Edward Young being also in the engine room, according to the most authentic evidence.

The whistle was blown to open the Main St. bridge, but for some reason there was no response, and the signal was given to the engineer to back his engines. At the same time the second signal was given to open the bridge, and the boat having checked her forward motion, the signal to stop the engines was given at or about the same time as the whistle was blown.

About five seconds after the second whistle, according to the majority of the witnesses interviewed, and without a moment's warning, the explosion followed. There were 2 distinct reports according to persons near by, about a second apart.

The starboard boiler left its place in the fire hold beside the one shown in Fig. 1, projected itself forward and upward, tearing away the steel deck, and all of the steel I beams, channels, angles, and plates in its path, and came out on the deck at about the third hatch aft as shown in the foreground in Fig. 1.

Just forward of this hatch, was the deck house which was about amidships. This was pulverized completely except about 10 ft. of the roof which remained intact. The boiler then continued onward and veered slightly to the right, one deck hand having the presence of mind to dodge it and it passed over his head by a close margin.

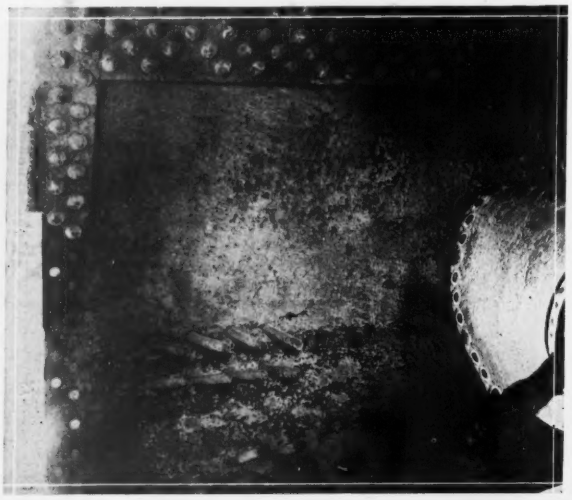


FIG. 4. VIEW INSIDE BOILER, SHOWING PITTING AND GROOVING ON BOTTOM OF SHELL UNDER COMBUSTION CHAMBER, AT THE RIGHT IS REAR END OF FURNACE WHERE INITIAL RUPTURE TOOK PLACE

The boiler struck the wooden structure comprising the cabin, and pilot house, besides quarters for the members of the crew, and from there glanced upward and to the right, mounted into the air possibly about 50 ft. crashed through the side of Bauman & Murphy's coal shed taking with it 100 ft. of track and several cars, one of which can be seen in front of the boiler in Fig. 2.

Fire immediately broke out in the hold of the vessel, and a third alarm brought the entire fire department of the city out. The hazy condition in Fig. 1, just in front of the remaining boiler, is caused by the blaze of the fire, this picture being taken about 15 min. after the explosion.

As soon as possible, the remainder of the crew many of whom were more or less injured, promptly attempted to save their late shipmates assisted by the life saving crew who saved the steward, his wife and one of the mates, off the stern of the vessel where the stack and other debris completely surrounded them, but none were injured.

The entire deck, bulkheads, and partitions near the engine room were blown off, the chief and first assistant engineers were found against the bulkhead right behind the engine, dead and frightfully scalded, the chief having the piston rod of the steam reverse gear through his head.

Four men were killed instantly, literally boiled to death and badly crushed, two of them so badly that recognition is impossible. Two others died in the hospital soon after removal. One body was never found although the river was dragged and the hull searched.

Investigation was immediately started by several different authorities, the completeness of the wreck and the scattered location of it making it a tedious task.

The entire back end of the boiler was torn and stripped off and projected backward beside the engines and landed mostly in the stern. Most of the tubes remained in the front head but are projected through the sheet and battered over as seen in Fig. 2, by coming in contact with obstructions in its flight, as is borne out by the head being bumped inward, and by the incisions in the sheet.

When the boiler glanced off the cabin, it turned completely over and landed on its back and end for end from its original position. The rear head in its backward flight, struck the side of the boat with sufficient force to rip open the 5/8-in. plates from the gunwale to about 6 in. below the water line at the time, but the boat listing to port, saved the vessel from sinking. See Fig. 3.

The outside back head ripped in two at the seam, and the top half folded upward as far as the through bolts would permit, shearing the rivets off clean. The lower half sheared the rivets all but about 3 ft. at the bottom.

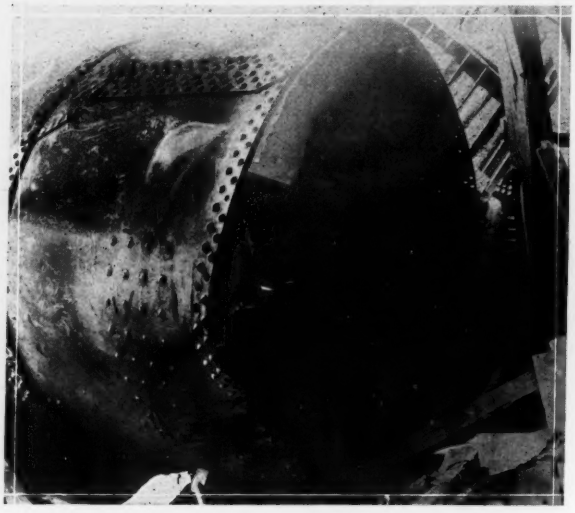


FIG. 5. REAR END OF BOILER WITH SECTION OF BACK HEAD ON SHELL

Right here is one of the several vitally weak places in the boiler, as the pitting and grooving extend entirely across the sheet and are as much as 5/16-in. deep in places. Figure 5, taken at close range, shows the defects very clearly.

The writer in company with several inspectors of state and national reputation devoted almost 2 days to collecting the parts, getting them as nearly as possible to the original positions, and comparing the parts which had formerly been together in an effort to discover if possible why the explosion took place and where it let go first.

In Fig. 4, can be seen the rear end of the right hand furnace, (from the firing end of the boiler). This shows that some enormous pressure from the steam side forced it inward, and the inclination of the staybolts bear out this theory strongly.

The T iron on the bottom of this combustion chamber was not found, but examination of the fire side of this sheet shows strongly that the heads of the rivets were corroded almost off. This would also help out the theory that the bottom sheet of this combustion chamber was the scene of the original fracture.

The combustion chamber sheared all the rivets at the back head of this right-hand furnace, except a strip of about a foot, which is shown in one of the smaller illustrations.

This strip was corroded in places till there was barely 1/8-in. of metal left, and that was crystallized. This bottom sheet was folded upward and to the rear of the boiler, where the force of the blow was thrown against the cross seam of the back head, and the

The through stays below the furnaces, show that the holes in the end have become greatly elongated with time, and that the metal had lost all of its elasticity, and was crystallized. Also that in some, the metal showed signs of having been burned in the process of manufacture when first made.

The process of corrosion has been a long one, as the plate is eaten away at the joint about a quarter of an inch for nearly 2 ft., and in spots up to 3/8-in.

One soft plug was never found but the other was as good as new. There was no evidence that the water had ever been low; at any rate, in recent times. The boiler had just been cleaned within a week, and there was practically no scale.

It was believed from the best information obtainable that the working pressure was 150 lb., none of those who ought to know putting it at less than 140. The pop valve off the boiler in the boat relieved under test at 150 lb., while the one off the exploded boiler relieved at about 120 lb. although it leaked a little from 80 lb. up.

FIG. 6. RIGHT COMBUSTION CHAMBER AND ENGINE AFTER EXPLOSION

FIG. 7. LEFT COMBUSTION CHAMBER AND BOTTOM BACK ARCH ON DECK

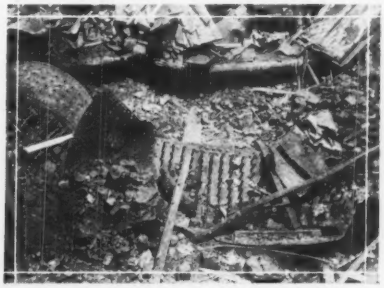


FIG. 8. ANOTHER VIEW OF FIG. 7

FIG. 9. ARROW SHOWS GROOVE 1/4 TO 3/8 IN. DEEP BY 2 FT. LONG IN REAR SHEET OF SHELL

FIG. 10. VIEW OF WRECK FROM BRIDGE

FIG. 11. STUDYING GROOVING AND PITTING IN LOWER SHEET BACK HEAD

approximate radius of this outward bulge in this sheet and in the rear sheets of both combustion chambers, are about the same.

With the entire rear end out, starting on the bottom, the boiler was projected forward and upward in practically an inclined straight line, in spite of steel decks, beams and other obstructions, till the direction was changed by the cabin, otherwise the boiler would have landed in the river.

Many of the staybolts were broken either entirely, or for a greater portion of the sectional area and corrosion on the ends showed the fractures to have been old. The grooving was very bad around staybolts and many instances were present where corrosion had reduced the thickness of the metal to 2 threads. In one instance a small knife blade could be thrust entirely through the sheet in the crack.

This pop, however, was broken off the boiler by striking an obstruction, and which dented the shell deeply beside the valve and cracked the flange where bolted to the boiler.

Only one boiler was in use at the time, the other being washed and filled but not ready to steam up. The design of the boiler was such that it was impossible for a man to see the points where the worst defects were, although right on the bottom between the furnaces, excessive pitting was evident.

Sidelights on the Explosion

THE entire deck from the galley forward to the deck house was practically blown entirely away, (together with two men painting the stack,) and all the superstructure. This fell in the river and all over the neighborhood for several hundred feet.

A piece of the steel partition of the engineroom was neatly rolled up, thrown 600 ft. across the river and barely missed going through the roof of the power house of the Wisconsin Gas & Electric Co. This piece weighed 970 lb.

A piece of 2-in. pipe with a valve on it, stuck in the ground beside it in the middle of a flower bed, while the gage glass cocks were found on the beach, 75 ft. beyond, close together. A laborer tried to dodge a flying sheet of steel and finally took refuge behind a post and the plate struck within 2 ft., and nearly blinded the man with dirt. A rivet head struck a man at the same place and stunned him.

A piece of the 4½-in. fire main, 20 ft. long, went out of sight in the air, and landed across the river 600 ft. away going through the dock of the Goodrich Line. The pipe can be seen in the doorway of the shed at the upper extreme right of Fig. 1.

A laborer at The S. Freeman & Sons Boiler Co., had just straightened up from wheeling in a wheelbarrow, when a sheet 2 ft. square came through the roof and landed between the handles, while another man was badly wounded in the hand by another piece.

Rivets sheared off the boiler and boat, were found as far as 1000 ft. away, and in 2 instances in the rooms of dwellings. A number of windows were broken in the pumping station.

One of the boiler tubes was projected to the rear and upward, and broke a yellow pine 4 by 6-in. timber at the top of the tower shown at the extreme top in Fig. 1. It then dropped to the ground just behind a man going over to the boat. Many more bad accidents were narrowly averted.

The blast shook the entire city, and was at first believed to be the gas reservoirs. A man's hat was thrown 1000 ft. through the air and landed on the pier beside a dredge at the mouth of the harbor.

The consensus of opinion after an examination of the parts, points to old age and crystallization as the direct cause of the explosion, with part of the blame thrown on the design, which was such that parts most liable to fail were inaccessible. The boat is a total loss and will be turned over to the underwriters.

The engine was a triple expansion, 19,-32 & 52 by 39 in. stroke, arranged with the high-pressure cylinder in the middle, the intermediate forward, and the low-pressure aft.

CORRESPONDENCE OF AN OLD ENGINEER AND HIS SON

Oil and an Oil Agent

MY DEAR FATHER:—

I had to work overtime tonight to take off the back bonnets of the Corliss engine and see what the new brand of cylinder oil was doing, and found your very welcome letter awaiting me at the supper table, and it was "the magic balm that, once applied, removed that tired feeling." (This isn't Shapespeare, it is MacDougalspeare.)

I was very tired and hungry and, I'll admit it, a little hot under the collar, too. The manufacturer of the engine thought the back bonnets never got hot, so didn't tap them for eyebolts, and I guess that you have been in the business long enough to know that a hot back bonnet is not the pleasantest thing in the world to handle at short range.

Well, both a ruffled temper and a blistered thumb will heal with the lapse of time; in the present instance, the letter from home takes care of the former, while a little cylinder oil helps the latter quite a lot.

You see, father, this day and age is some different from the tallow cup and other such inconveniences as you were accustomed to, and the oil problem is not all that the oil agent tries to make you believe. I think that the continual association with lubricants is what makes the average oil agent such a smooth proposition? Don't you?

We have had very good success with the oiling system that I told you about several weeks ago, and it is paying bigger dividends on the investment than the money the company puts into finished goods. But, as the fellow said, "life is just one cussed thing after another," and we are having our troubles with the internal lubrication problem, or rather, I might say, have had, for the last prescription has either "proved itself the proper remedy, or else created a new disease."

We were using the 550X brand of cylinder oil for some time and were having very fair results, that is, for the wide range through which we have to use it, on pumps, high and low speed engines, 1, 2, and 4-valve engines, simple, compound, and triple, some pistons with snap rings, and some with steam set rings and others with spring set rings.

It is part of the old man's creed to look inside of things about every so often and see how things are getting along. Everything had been pretty fair, as I said, till we got another lot of 5 barrels of cylinder oil, and then things began to happen.

Valves began to groan, and stick, and on some engines it seemed to take fully twice as much to do the same work, while on others the more we pumped in, the worse it got, till we were all disgusted. Although we have as good oil separators as there are anywhere, yet we began to get oil in the boilers.

I half imagined that the Chief had a notion that we were prejudiced against the oil, or the firm, or something, or that we were "plugging" in favor of some other oil or firm. Yet, he didn't say much, only to keep close watch of it. One day the agent called, and let me say, father, that he fully lives up to his reputation as a "smooth proposition."

He talked more and said less in about an hour than any man I ever saw and the sum and substance of his talk was to the effect that we didn't know how to use cylinder oil. That is a stock expression of all of them, but this time, the agent sort of put his foot in it, for, while the Chief is a very modest man, and doesn't claim to know very much, yet it isn't healthy for anyone, especially an oil agent, to tell him of it.

They had words, and the agent left, saying that perhaps there really MIGHT be something wrong with the last batch of 25,000 barrels that they had just received, and a lot more talk like that. He said that he would go right back to the office, and get Cleveland, on the long distance, or Cincinnati, or some other town,—I don't recall now,—and raise cain about it. Well, he overreached himself. It seemed that nothing short of barbed wire could hold the things he intended to say to the fellow at the other end and it looked suspicious.

So I did a little detective work on my own account. You remember my speaking about Crissy

Montgomery who had to go to work because his father was on the wrong side of the wheat market a few years ago? Well, Crissy is with us now, in the office, looking after part of the sales end. I 'phoned him to come to the engine room at once, and quickly explaining, started him on the trail of the oil agent.

In an hour he returned, followed in a few minutes by the agent. Oh yes, "there had been some mistake at the other end," so the agent said, and "what he said to the General Manager at the other end was a shame," according to his story of the 'phone conversation.

And yet, father, as old a man as the Chief is in the game, he took the medicine straight, and when the agent said he would have the wagon call and get the remaining barrels of oil, and replace them with some of another brand that he had just received from the refinery the day before, the Chief cooled off and said, "all right."

More work for Crissy. The agent didn't say why he didn't bring the new oil up and take the old oil back, instead of taking the defective oil back to the warehouse first, and making another trip in order to bring us the new oil.

Well, in about 2 hr. after the old oil left, the team brought back a new barrel of cylinder oil with the paint still damp on it. The agent called the Chief's attention to this, in order to prove that the oil had been received from the refinery the day before, "in the original package."

We used it for a week or so, and of course there was no change for the better; in fact, matters got worse, so the Chief had the agent call again. The agent actually tried to prove that the engines were running better, and really earned his salary for a while.

I called the Chief over to look at a trap that was working all right, while the agent was listening to the engines all over with a stick in his teeth and his fingers in his ears. The Chief listened as if his salary was being doubled, and he called me out into the boiler room where he slapped me on the back, and laughed good and hard.

He went back to the agent and I sent for Crissy. Crissy strolled in with a few papers in his hand looking little like the "man-out-of-work" disguise that he had assumed while emulating Wm. Burns. Then the Chief said to the agent.

"Well what did you say to those people over at Toledo, or Toronto,—where was it?—and what did they say? Tell me exactly, now, for I want to get to the bottom of this thing."

"Well, sir, Chief, it was (here, have a cigar) it was a shame, the way I ripped the manager up the back over the 'phone about that oil. I told him that he dare not—DARE not, mind you,—dare not trifle with my best customers in this unscrupulous manner, and that if that was the way he did business, he could go to hades, refinery and all, and that I would go and get a position with the Foster-Lockwood people.

"Why, Chief, central threatened to cut me off and have me arrested and all that and I defied her. Yes, sir, defied the telephone trust. I turned that refinery inside out, believe ME. I won't stand for this kind of business,"—and the way that oil agent laid out those big guns in order to save 5 barrels of oil, was a caution.

Father, if it hadn't been so tragic, it would have been laughable. Then he went on about this new brand of oil, this "Diamond Superheat" brand, as he called it. The Chief put in a word now and then, and it was like throwing the governor belt off, for the agent fairly outdid all former records.

"Are you sure, quite sure, Tom, that you had the main office on the long distance? and that you——" began the Chief.

"Sure! Sure? Sure I'm sure. Didn't it cost me $2.35 just to tell them that you were a valued customer of mine, and that——"

"And that this new barrel is really that brand of 95 cent 'Diamond Superheat' oil that your company spent $65,000 to perfect?"

"Well it certainly is, and if it hadn't been for——" began the agent when Crissy, in response to a wink, cut in with:

"Say, but I should think that you would make pretty good money writing plays. It is a shame to spoil it, but as a matter of fact, didn't you leave here that day and call up your wife and tell her that you would not be home to dinner, or lunch, as you would-be-wealthy people call it, and didn't she tell you that she wanted some money, for you said that you had only a balance of about 75 cents in the bank?

"And that day that you were foxy enough to get the oil from here first before bringing up the new barrel, you took back 4 barrels, to your warehouse, unloaded only 3 and painted the fourth, right on the wagon, and stenciled it 'Diamond Superheat.' In fact, you did the stenciling yourself, for you got some of the blue paint off the barrel on your gray trousers and you swore at the man for putting on too much paint, and there is the paint on your trousers yet.

"As a matter of fact," continued Crissy, getting warmed up to his subject, while the agent was as white as a sheet, "this barrel of 'Diamond Superheat' that you bragged up so much is one of the barrels you took from here,—one of the original 5,—and those 5 were the result of an experiment of yours, trying to compound an oil and using your best customers as 'goat' to experiment on. That is so, and you know it, too."

"W-w-w-why,—h-how did—you find it out?" stammered the agent in dismay. "Wh-wh-where were you?"

"Well, I trailed you that day you were supposed to have fused the wire from here to Oshkosh, or some place, and I can tell you just where you went and what you did. You 'phoned your wife from Sandifer's grocery, because it was free, instead of using the pay station at the drug store.

"I went into your office and asked for a job just to get a chance to see the way you were flim-flamming the Daneberg Mfg. Co. I guess that the goods are all wool and warranted not to shrink, ain't they, old man?" said Crissy as a wind-up.

The oil agent slowly headed for the door, through which he passed, 20 yr. older. Father, right down in my heart, I was sorry for that man. Really I was. He has no trade, he knows no business but that of selling lubricating oils, and he has been proven to be so crooked at that, in this town, that he has to sleep in a house with a wing on it.

We all looked at each other a while, the Chief, Crissy and I, and finally the Chief said: "Boys, that was a mighty fine piece of work you laid out, and got away with. Crissy, you ought to be on the Chicago police force, instead of having your nose stuck in a sales directory around here. Where did you boys learn to do that kind of a stunt, anyway?"

"Back at the Bergville Technical Institute," said Crissy, and he left for the office as if it were an everyday event. The Chief sat at his desk thinking and laughing, and finally picked up the 'phone and ordered up a barrel of oil from Jim Hendrie, another oil agent. Jim has the reputation of being so straight that he could tramp meal in a gun barrel.

And this all brings me back, father, to the cylinder oil problem again. We had the usual time experimenting with everything till we got the feed set just right, and tonight when I examined the exhaust valves, they were getting plenty of oil, which is a drop every 20 revolutions, and as the cylinder is 15 by 36 in. this means that one drop of oil lubricates about 275 to 300 sq. ft. at a temperature of about 360 deg.

Tell mother that Hazel wants to know how to knit socks with ribs in, and how to knit mittens with 2 colors of yarn. Here is her address on a separate slip of paper, so mother can write direct. They might as well get acquainted now as any other time.

Affectionately your son,

Donny MacDougal.

FOREIGN POWER PLANT DEVELOPMENT

Low Explosion Motor

By J. H. Blakey

AT the Glasgow (Scotland) exhibition of 1901 there was exhibited an engine run by gas which it produced itself from powdered coal fed into a hopper. It attracted some attention at the time, but it was not a success, for some unexplained reason, and it has not been heard of since. Recently Dr. Archibald Low, of England, has produced an engine of the same type which has been so successful that a great deal is

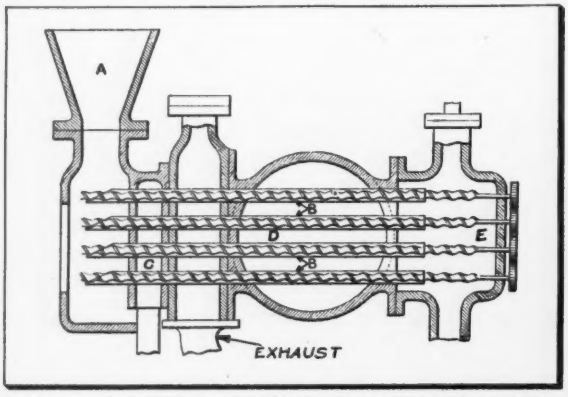


FIG. 1. TRANSVERSE SECTION OF LOW EXPLOSION MOTOR

now expected of this form of motor. The last engine built is one of 100-hp., with 1 16-in. cylinder, and it is claimed that its consumption of fuel is only half a pound per horsepower hour. This small consumption alone would commend it to all users of power, but in addition it uses small bituminous coal or coal dust which can be bought for $1.25 a ton—about 1/10 of the price of the cheapest crude oil.

Excess of weight of the combustible over the Diesel motor is about 30 per cent. It owes its high efficiency to the large use which is made of what in other motors is waste heat. Except for the gas producer at the back of the cylinder, its dimensions are no greater than that of a gas motor of the same capacity.

Danger of accident by an explosion is reduced to a minimum because the gas is produced only as it is needed. It has one defect, however: it is not self starting; but it may be started with any kind of gas, and after running for 2 or 3 min. it is able to take care of itself.

Attempts previously made to feed an engine with unwashed gas have resulted in a tarry deposit in the cylinder, which soon proved very detrimental to the working of the engine; the Low motor seems to be free from

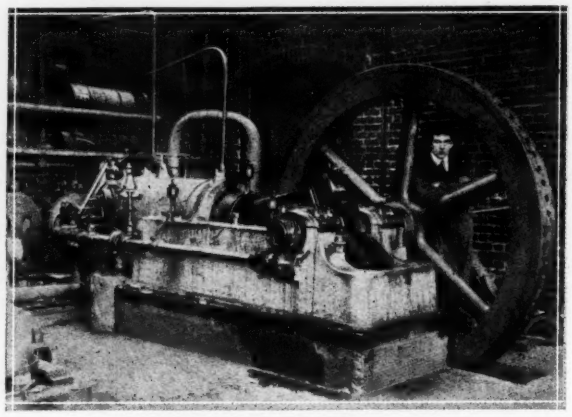


FIG. 2. COMPLETE LOW MOTOR

this defect, which is attributed to the fact that the cylinder never gets cool enough to condense the gas supplied to it.

Referring to the drawing it will be seen that A is a hopper into which the coal is poured, and into which project the ends of the 4 tubes B, each containing a conveyer screw which terminates in the cinder chamber E. It will be noticed that the ends of these tubes are open to the air in the cinder chamber. In the 100-hp. engine these tubes are 2 in. in diameter, and are pierced with half-inch holes in that part which passes through the gas chamber C. This chamber connects with the

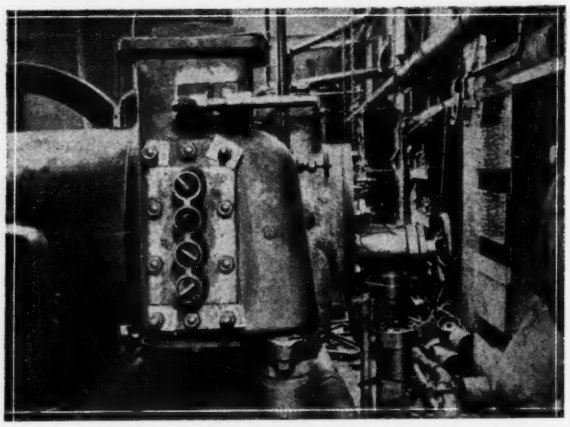


FIG. 3. CYLINDER END OF LOW MOTOR

cylinder D, and in the supply pipe is an automatic valve which is set to admit the correct quantity of air. The tubes B run through the cylinder, from which is taken the heat to produce the gas. The engine is run at a cylinder pressure of 90 lb. per square inch. In the 100-hp. model the coal supplied may be as large as a quarter of an inch, though in the earlier models made for experimental purposes the coal used was not coarser than sugar.

LETTERS DIRECT FROM THE PLANT

Cash Paid For Ideas Accepted. Sketches Desirable.
We Make The Drawings

FINDING RADIUS OF FLANGE

HAVING read W. Simpson's article on finding the radius of a flange in May 15 issue, I am sending in a rule that I have used for several years. Taking Mr. Simpson's measurements, let B D = diameter of the arc of the flange. Then A B C and D A C are similar triangles and B C is to A C as A C is to C D or, by substitution and expressing the operation in the form of arithmetic,

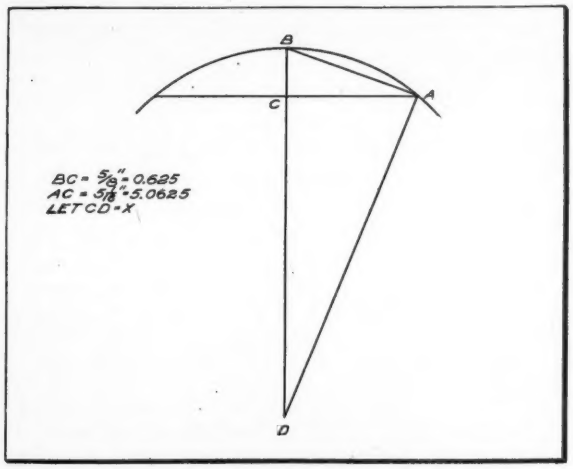


DIAGRAM FOR FINDING RADIUS OF FLANGE

$$\frac{0.625}{5.0625} = \frac{5.0625}{\times}$$

$$\times = \frac{5.0625 \times 5.0625}{0.625} = 41.006{,}25 \text{ in.}$$

$$41.006{,}25 + 0.625 = 41.631{,}25$$

$$41.631{,}25 \div 2 = 20.815 + \text{in.} = \text{radius of flange.}$$

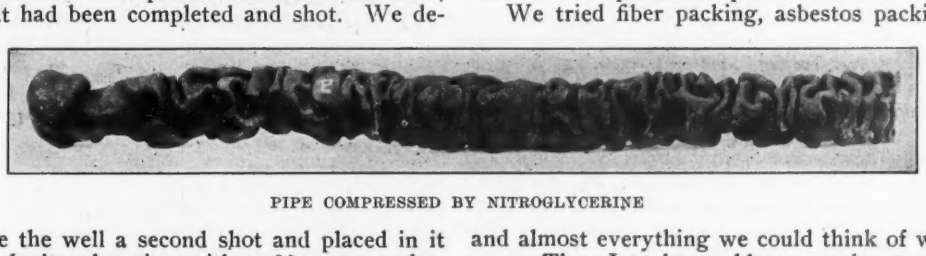
F. R. Lewis.

Strength of Pipe

WE recently shipped National Tube Company a joint of 5 3/16-in. casing for inspection. This joint was part of a liner which we placed in a well near Gore, Ohio, after it had been completed and shot. We decided to give the well a second shot and placed in it 150 quarts of nitroglycerine with a 20-quart anchor shot. We then pulled the liner and after getting it out we discovered that one joint was still in the hole. We decided to put the shot off with the hope that the joint of liner would come out following the shot. It, however, lodged about 1500 ft. from the top and after working with it for some days we were able to put a bell socket over it and brought the joint out in its present condition. This well was 3000 ft. deep and the 6 5/8-in. casing was not damaged in any way.

It will be noted that length of casing which is normally about 18 to 20 ft. was compressed to a length of about 8 ft., but careful examination will show no fracture in the material notwithstanding the enormous punishment to which it was subjected. We believe this demonstrates the fact that the material which enters into National pipe is of the highest quality, otherwise it would not stand such unusual and severe punishment and distortion as is shown in this case.

L. F. H.

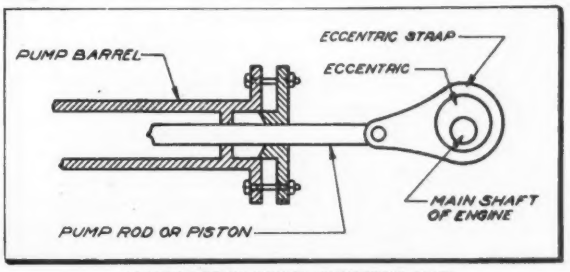


PIPE COMPRESSED BY NITROGLYCERINE

METALLIC PACKING

REPLYING to Charles J. Mason's inquiry in regard to the use of metallic packing for pumps, issue of April 1, I have the following to say:

An engineer, running a gasoline traction engine, had trouble with the circulating pump. The lift was only about 6 ft., but even with that he couldn't get packing to stay in the pump. The illustration shows the pump in outline.



CIRCULATING PUMP STUFFING BOX

On examination I found that there was no guide for the pump rod, which also acted as piston, except the stuffing box, stuffing and gland. Consequently, there was an up and down motion of the pump rod as the eccentric pushed or pulled.

We tried fiber packing, asbestos packing, rubber, and almost everything we could think of without success. Then I took an old rasp and cut some babbit, which I mixed with No. 4 lead shot, graphite, and oil, and packed the pump with it.

The packing did not work out, and there was no binding, as the oil and graphite worked splendidly. The packing leaked some, but did better than any other we tried. The stuffing box was only about ¾ in. deep, and the pump rod about 1⅜ in. in diameter, and the eccentric made about 2-in. stroke. I believe metallic packing good if the rod runs nearly true.

Edward Skillman.

DEFECTIVE VALVES

ENCLOSED find a sketch of a slide valve as used on an engine; the defect was not discovered for several years when the engine was over-hauled and repaired. Port A did not come into use until the valve had made about half its movement.

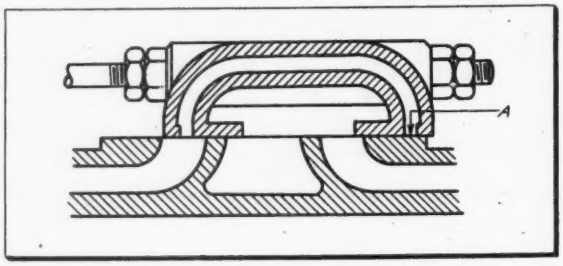


FIG. 1. DEFECTIVE SLIDE VALVE

Figure 2 is a sketch of a double ported piston valve which had been repaired, but the engine did not work right and was taken apart to find the cause.

This was a high-speed engine and the steam admission was not quick enough. It was found that when port A was beginning to open, port B had ¼ in. yet to travel before it would open.

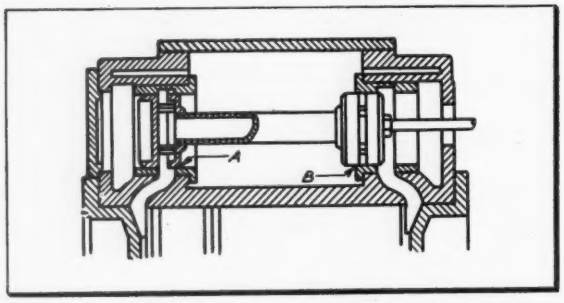


FIG. 2. PISTON VALVE WITH INCORRECT PROPORTIONS

Cases like this show that it is not well for the engineer to trust too much to the other fellow when the valves of his engine are being tampered with in any way.

J. G. G.

SOME EASILY REMEMBERED INSTRUCTIONS FOR SHAFT GOVERNORS

SUGGESTIONS given below for adjusting and handling shaft governors are not new but I have found a knowledge of them essential when taking examinations for license and present them to readers of Practical Engineer in a form easily remembered.

To increase the speed on a shaft governor put more tension on the springs, or take off weights. By putting more tension on the springs it will take more revolutions per minute to drive the weights out and overcome the tension of the springs. By taking off weights there will be less centrifugal force, and the springs will hold the smaller weights closer to the shaft than they can the heavier, therefore the speed of the engine will increase.

On the inertia type, to increase the speed of the engine put more tension on springs, or take weights from long arm.

There are 2 types of eccentrics in use with shaft governor, the slotted and loose eccentric.

The slotted eccentric on most engines does not change the lead, while in others it does to a certain extent; this eccentric moves across the shaft, changing the valve travel. An overhanging pin may be used in place of a slotted eccentric; it is more accessible and does away with the eccentric. With this governor the speed is controlled by shortening the valve travel, thereby giving an earlier cutoff.

With the loose eccentric, if it was on the main valve it would change lead at every change of load, as the governor changes the angle of advance of the eccentric at different loads, but the loose eccentric is only used on riding cutoff valves.

It must be noted that when the weights are in the outermost position the lead is not sufficient to cause the engine to run away with no load.

To tell whether a governor gives a constant or a variable lead, move weights out and in while the engine is on dead center and by watching the valve you can tell whether the lead changes.

Leon N. Webster.

BOILER FORMULAS TO BE MEMORIZED

THESE formulas, I think, would help many an engineer in an examination if committed to memory and I recommend them as a good mental exercise at odd moments.

$$BP = \frac{TS \times t \times Eff}{R}$$

$$WP = \frac{TS \times t \times Eff}{R \times FS}$$

$$FS = \frac{TS \times t \times Eff}{P \times R}$$

$$S = \frac{P \times R \times FS}{Eff \times t}$$

$$t = \frac{P \times R \times FS}{TS \times Eff}$$

$$Eff = \frac{P \times R \times FS}{TS \times t}$$

BP = Bursting pressure.
WP = Working pressure.
FS = Factor of safety.
t = Thickness.
Eff = Efficiency of joint.
TS = Tensile strength.
P = Actual pressure.
R = Radius.
S = Actual stress in metal at joint.

R. F. Price.

IN THE FIELD of safety elevator working, a notable new departure is the Newson Cableless elevator, which is operated by square threaded nuts, with safety lips operating on threaded columns, placed at the corners of the elevator shaft. The invention has been perfected in the west, and a trial installation is now operating in Salt Lake City, where a test was recently made.

CONDENSER OPERATION

I BELIEVE that the method described in the article on page 555, of the June 1 issue of Practical Engineer, regarding condenser surface, is rather antiquated, as I will attempt to show, and the solution offered is by no means one that can be worked out by the ordinary laymen. S and W are all right, but T is rather hard to arrive at. Would it not be better to decide first what vacuum the condenser is to maintain, and then, from a steam table get the temperature of this vacuum? This will make it far easier to arrive at. Also t is too indefinite a figure, and when estimating condensing surface, you naturally want to get at the exact amount of surface necessary for given requirements, rather than assume any approximate figure. The best way to arrive at this is to take the temperature of the circulating water, and add this to the same figure plus 15; then divide by 2. As an example, assume that we have circulating water at a temperature of 70 deg. Present condenser practice demands that the out-going circulating water is figured at but 15 deg. rise, which makes the outgoing water 85 deg.

$$\frac{70+85}{2} = \frac{155}{2} = 77.5 \text{ mean temperature.}$$

Again L is not wholly correct, as modern condenser practice calls for each pound of steam containing 1000 B.t.u. This has been determined by actual practice and experience. I presume your c, the figure which is mentioned as 180, is the co-efficient of heat transmission. The writer is extremely low in this figure, for the reason that this is usually figured on at 300 or more. The largest condenser builder in the world, who is very conservative in estimating, figures 300 as the co-efficient of heat transmission. Others figure 350, 400, and ofttimes 450. The writer does not believe, however, that any figure over 300 is safe, for the reason that it is only natural that after a condenser is in operation some little time there will be a settlement bound to accumulate on the inside of the tubes, which will greatly impair the heat transmission.

Now, figuring the same problem that was mentioned in the article, by my way of figuring, you will arrive at the following figures:

$$\frac{15{,}000 \times 1000}{300\left(125 - \frac{70+85}{2}\right)} = \text{Square feet of cooling surface.}$$

You will note in the above that we are taking 125 deg. as the temperature of the steam. In modern condenser practice, it is usually a 26-in. vacuum that is figured on for engines running condensing, and the steam temperature corresponding to this 26-in. vacuum is 125 deg.

This gives us

$$\frac{15{,}000{,}000}{300\ (125 - 77.5)}$$

$$\frac{150{,}000}{3 \times 47.5}$$

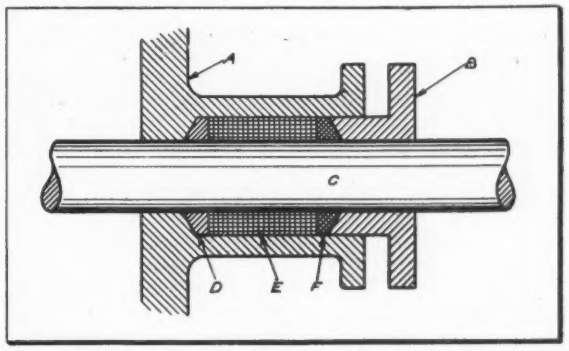
$$150{,}000 \div 142.5$$

$1{,}500{,}000 \div 1425 = 1053$ sq. ft. of cooling surface.

It is evident from the article that the author figured on the temperature of the ingoing water at approximately 68 deg., and coming out 15 deg. higher, or 83 deg. If the problem is worked out on this basis, then but 1010 sq. ft. would be recommended by any of the conservative builders. N. Owitz.

METALLIC PACKING FOR PUMPS

REPLYING to the letter of C. J. Mason, on page 378 of April 1 issue of Practical Engineer, regarding the use of metallic packing for water ends of pumps, I am submitting a sketch of packing which has proven satisfactory. The sketch shows an ordinary form of stuffing box in which A is the body of the box, B the gland, and C the piston or plunger. D is a solid piece of cast iron turned to fit the stuffing box and then sawed in 2 pieces. E is a soft metallic packing and F is a flax packing.



CROSS SECTION OF A SUCCESSFUL METALLIC PACKING FOR PUMP RODS

This outfit is made by the Elastic Metallic Packing Co. It has been on the boiler feed pump for about 3 yr. and is still as good as ever. It, of course, has to be followed up occasionally, especially when there is great change in the temperature of the water. The flax packing takes up any weeping that occurs past the metallic packing and the small flax packing has been renewed about once or twice a year.

This style of packing has been adopted for all cold water pumps as well as the boiler feed; for these pumps Belmont packing is used in place of the flax, but this is really a flax packing with a covering on it.

W. F. S.

SOME INTERESTING DETAILS of the work being done at Falls Village, Conn., in the construction of the great power plant, were recently given, according to the Connecticut Western News. It is proposed to utilize the old high level canal from Great Falls for about 1600 ft. to a point opposite the pool at the foot of the rapids below the falls, taking water from the canal to a power station on the river bank at the pool.

A low concrete dam will be built across the river on the ledge just above the railroad bridge, extending under the bridge at the east end to an intake to be built just above the original intake of the old canal. This intake will be of concrete with headgates to control the amount of water flowing into the canal, and will also be provided with gates for sluicing off ice and floating debris, as well as sediment.

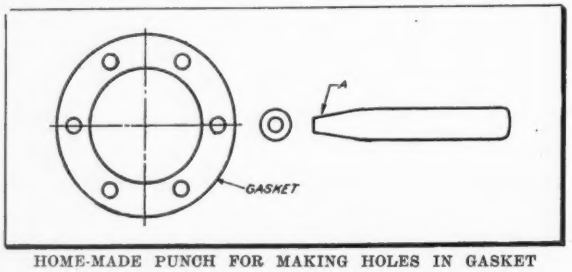
It is proposed to deepen the old canal and make it tight by lining with concrete or other method which may be worked out. At the lower end it will be enlarged into a forbay and intake for the penstocks. This forbay will be provided with headgates controlled from the power station, one gate controlling each of 3 penstocks to the water wheels in the power station. Space will be provided for a fourth headgate and penstock. The power station will contain 3 4000-hp. waterwheel driven generators, each being supplied with water from one of the 3 penstocks, a total of 12,000 hp.

Successful Kinks From The Plant

For Saving Time, Work and Trouble

Improvised Gasket; Tool for Cutting Bolt Holes

J. C. LEE'S article in May 1 issue calls to mind a little experience I once had with a Fitchburg Blake vacuum pump. The gasket between the valve chest and cylinder blew out, one cold morning, and I did not have a piece of packing large enough to make a new gasket and began to think I would have to shut down until I ran across a piece of building paper the same as carpenters use between clapboards, etc. I cut the gasket out of this paper, put a good coat of graphite on both sides and then tightened up my cap bolts. The gasket worked fine until I got some rubber packing, and I think it would have lasted sometime if I had let it.



HOME-MADE PUNCH FOR MAKING HOLES IN GASKET

A cheap but handy tool for cutting bolt holes in gaskets can be made out of a piece of iron steam pipe. Use a pipe the size you want the holes to be and grind it as shown in the figure at A. I have a number of them and find them very handy in a case like packing flanges on boilers, etc., when I cannot get at flange to cut out gasket with a ball peen hammer. It will be best to lay packing on a soft board before cutting holes as the iron pipe is rather soft and if it comes in contact with anything hard it will turn the edge.

A. A. Williams.

On the Center

FOLLOWING are a few methods of "getting the engine off the center." Figure 1 shows a small piston which may be used with either water or steam pressure. Opening either valve A or B gives pressure to

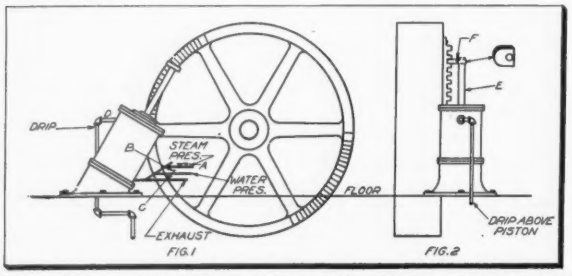


FIG. 1 AND 2. VIEWS OF DEVICE FOR TURNING ENGINE OFF CENTER

the piston while valve C is shut and by closing A or B and opening C the cylinder will drain and the piston come down ready for another push. Pipe D is to drain any leakage which gets by the piston. Figure 2 shows another view. By inserting a pin in hole F the piston rod is turned around out of engagement.

Figure 3 is another handy arrangement, having the derrick gear rig a small boy can take a large engine

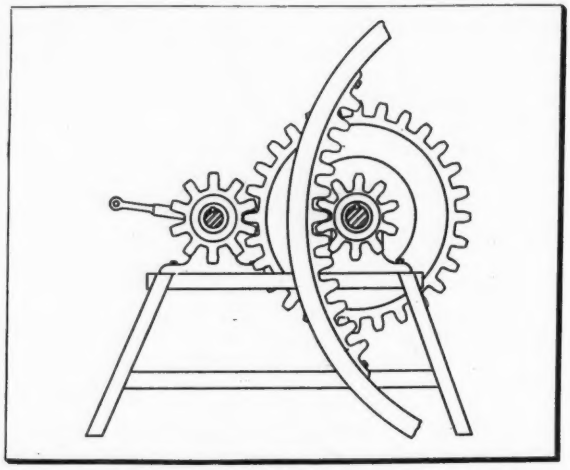


FIG. 3. GEAR WHEELS ARRANGED TO TURN ENGINE OFF CENTER

off center, the gear on the wheel is about 4 ft. long, a section being placed opposite each center. The above methods may be discarded with the right man at the throttle.

A. C. Waldron.

Practical Pointers for Steam Plants

DO not use slice bar too hard on brickwork, you may crack the brick; clinkers will also protect the bricks some, from the heat.

If clinkers stick to grate bars or you think you have a dead fire, try water in ash-pit.

Never put water in the furnace, in order to cool the fire as you may crack the grates, bricks, dead plate or door linings, and you are liable to get cool water on fire sheet.

Never take anyone's word that the boiler is clean, look for yourself.

Don't use your good coal shovel for ashes, clinkers or hot fire and it will last longer. In blowing out water column, first blow out sediment chamber, by opening valve on the lower pipe, then shut off combination valve and blow out through bottom valve then open top and shut the bottom valve and blow through top valve, first and last blow gage cocks, from bottom and top.

Don't run towards the door if gage glass bursts, run the other way and first shut bottom combination valve, then the top, take off nuts and cool them off, don't spoil the thread with the knife when cleaning them, clean inside of combination valve, blow out through top and bottom, be sure they are clean, I

have seen 5 glasses break in succession on account of a small piece of glass left in the bottom. Be sure that glass is the right length, ½-in. inside each valve, see that valves are in line, tighten up nuts easy for a start, shut valves and tighten up 2 or 3 times, soak glass and washers in hot water before putting in, try gage cocks while glass is out, if short of washers, try valve stem packing.

Connect lubricators so as to feed the oil through reducing valves to pumps or engines, if reducing valve sticks, take it apart and clean it with kerosene.

Do not under any consideration connect discharge from traps direct to sewer; if more than one trap is connected to discharge into sewer, connect them so you can tell which one, if any, is leaking. Take traps apart twice a year, if closed discharge.

Put graphite between disc and disc holder, when putting in new disc, also on thread and bonnet.

If safety valve sticks, open or closed, don't start to hammer the valve, give the valve 3 or 4 good long blows; if that doesn't help, take valve apart and investigate.

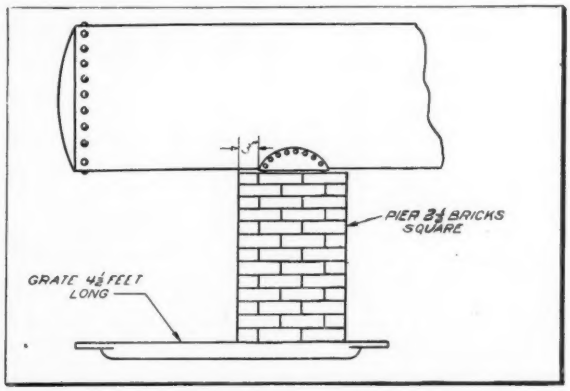
If steam gage doesn't correspond with safety valve and damper regulator, disconnect it, blow out the pipes and clean gages and check, if still wrong, with a gage that you know is correct. It hardly pays to repair a worn steam gage in the shop.

Never use monkey wrench on valves to close them. If escape pipe is connected to safety valves, be sure to take strain off valves.

Don't get into the habit of calling for outsiders to do any work, if you can help it; practice is the best teacher. C. M.

Patching a Boiler

IN February, 1912, we had a patch put on our 72 in. by 16 ft. boiler on account of a bulge 12 by 14 in. in diameter and 1¼ in. deep, which the boiler repair man said was too deep to be driven up again. To repair it he cut out the bulge and put on an oblong patch 16 by 21 in. He stated that, because of the location directly over the fire, about 18 mo. would be as long as we could expect it to last when another patch would be necessary, etc.



PATCHING A PATCH

Well, in less than 6 weeks leaks appeared at rivets and along the seam and it looked as though less than 18 mo. would see the finish. I would recalk the patch or have it done by a boilermaker; in either case, in 2 or 3 days it would leak again. At the end of 4 mo. there were 6 or 8 fire cracks and things were getting worse fast.

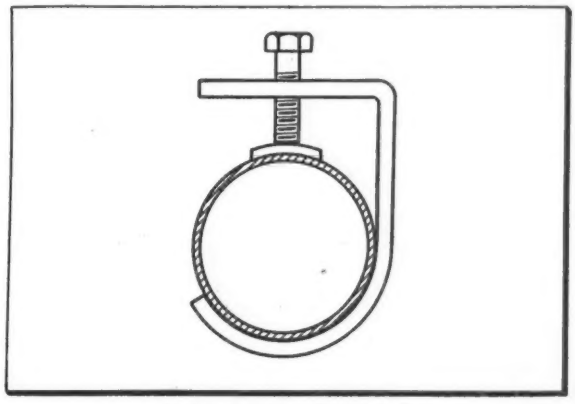
Thinking perhaps I could protect the patch with firebrick in some manner, I thought of building a pier under it as the best way. I had never read or heard of such a thing but thought I would try it anyway.

Securing a good quality of firebrick I built a pier as shown in the figure, which explains itself, the bricks just touch the rivets in the center of patch and extend 3 in. towards furnace door in front and an inch or more at sides; this was put in in September and has been rebuilt once since at which time there was one small leak at a rivet to be calked. A smaller pier could be made to cover the patch, but this size is much more substantial and less likely to be dislocated with the fire tools. The brick are put in without mortar of any kind. In service the brick become nearly incandescent, keeping the patch at a nearly uniform temperature at all times. I think now this patch will hold indefinitely. W. A. Watson.

Leak in Steam Pipe

THE illustration shows a clamp I once used to stop a small sand-hole leak in a steam pipe.

I took a piece of iron ¼ in. thick and 1 in. wide and bent it as shown in illustration, then drilled a hole



CLAMP FOR STOPPING LEAK

on the top side and tapped it out for a ⅜-in. set-screw. Then I put a piece of sheet packing over the leak, and a small piece of iron between that and the end of the set-screw. A. A. Williams.

A CAUSE OF SAVING that is not often thought of is discussed by J. Budd, in the Power User. It might happen that when a sight feed lubricator is used, if it be so located that it becomes chilled, it is impossible to get the oil to feed constantly in small drops and more oil is used than is needed. By so locating the lubricator that it is always warm to the hand, but not too hot, it is possible to get a regular feed, which in one instance amounted to a saving of 14 gal. of oil in 6 months, a very good saving for a little change in the location and piping of the lubricator.

OPPORTUNITIES ARE ABUNDANT for the man who pursues the right method.

It is not so much a question of ability as it is judgment.

The time spent in grasping temporary benefits, added to the work for a firm foundation, will bring you to success quicker than you hope for.

Accept trouble.

Build right.—Tips.

POWER PLANT CHEMISTRY

Calorimetry, Equipment Needed, a Complete Test, Determination of Sulphur

AS stated in a previous issue, the most satisfactory and practical method of determining the heat value of a sample of coal is by the use of a calorimeter. That this instrument has not become the daily companion of the engineer as has the steam engine indicator is probably due to the false mystery supposed to surround the chemistry which is involved, though the chemistry is easily understood and the entire test quite simple if the principles are thoroughly comprehended and the weighing and thermometer readings taken accurately.

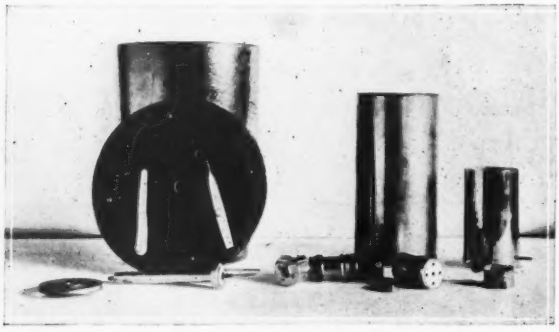


FIG. 1. PARTS OF A COAL CALORIMETER WITH ELECTRIC IGNITION

Calorimetry may be defined as the process of determining the amount of heat liberated by a chemical change. In our case we refer to calorimetry of coal, being interested in knowing the exact amount of heat which is liberated when coal unites with oxygen. The instrument employed is of some form so that all heat liberated during combustion is absorbed by a definite amount of water, the temperature of which can be determined at all times during the test.

As might be expected, there are a number of different types, but for the engineer in the plant a Parr calorimeter will serve the purpose nicely, although it has been recognized as not so accurate as a bomb calorimeter, but is more easily operated.

The outfit consists of a calorimeter, thermometer graduated to 1/20 deg. F., a 2-liter measuring flask, a chemical receptacle, a measuring cup, a 100-mesh brass sieve with bottom, chemicals sufficient for 50 determinations, pincers, ignition wire, reading lens and a camel's-hair brush. This entire outfit may be secured for $70 with wire ignition and $75 with electric ignition, and under proper care should last a lifetime.

The more convenient method of igniting the coal is by electricity; the parts of such an instrument are shown in Fig. 1 and the determination which follows was made with this instrument.

Figure 2 is a cross section of the instrument with details of the construction of cartridges for hot wire and electric ignition. The outside casing is in 2 parts, B and C, separated by air space and made of papier-mache. An air space separates this casing from nickeled calorimeter can, A, which contains the water. A cylinder, E, open at top and bottom, serves as a deflector to aid the circulation of water. On the bomb, D, are wings, G, which propel the water when the bomb is rotating. The cartridge rotates on a pin, F, when a test is being made, being kept in motion by a band running over pulley, P, on the stem of the cartridge.

Referring to Fig. 2C, it will be noted that the cartridge consists of a shell, A; the removable bottom, C, held in place by the cylinder, E, and screw plug, D; the ignition device which is held in place by the cap, F. The parts, D, E and F, have holes in them which aid in conducting the heat from the cartridge to the water. H and I are binding posts for a fuse wire, G, which is blown to ignite the coal. Connections from the electric source are made at K and on stem B, these being electrically insulated from each other, by means of the contacts shown on the cover in Fig. 1.

Determination of B.t.u.

THE amount of coal used in making this determination was 0.5 gram, which had previously been dried, passed through a 100-mesh screen and was accurately weighed. This was placed in the cartridge and with it were placed 0.5 gram of potassium chlorate, used as a flux, and 10 grams of sodium peroxide (Na_2O_2) which is called the accelerator and furnishes the oxygen necessary for the combustion of the coal.

With the fuse G in place, the cartridge was closed and the cap F screwed tightly in place. The coal and chemicals were then mixed thoroughly by shaking the cartridge vigorously. The wings G, Fig. 2A, were then put in place and the cartridge put into the calorimeter can, which contained 2 liters of water at about room temperature and the calorimeter was then completely assembled.

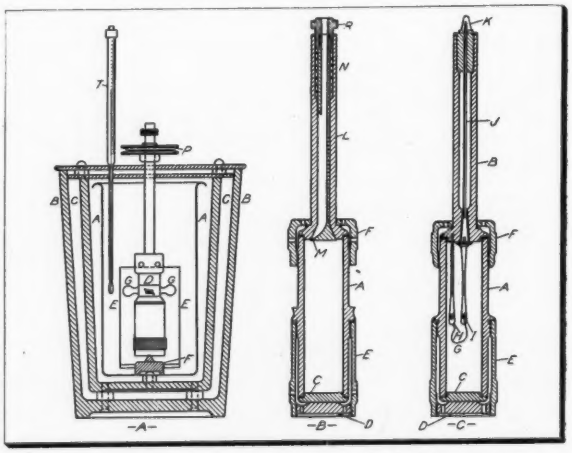


FIG. 2. CROSS SECTION OF PARR CALORIMETER AND CARTRIDGES USED IN IT

With the thermometer T in place, the cartridge was revolved rapidly until the temperature became constant at 70.07 deg. F., then the electric circuit was closed, the fuse blown and after ignition the circuit was opened. The temperature immediately began to rise and thermometer readings were taken every minute with the aid of the reading lens, when the temperature of the water began to decrease the test was completed. The highest temperature reached was 74.66 deg. F; the difference between the initial and final temperature was therefore $74.66 - 70.07 = 4.59$ deg. F.

The chemical changes which take place during combustion are as follows:

$$Na_2O_2 = Na_2O + O \quad \ldots\ldots\ldots\ldots (1)$$
$$C + 2O = CO_2 + \text{heat} \quad \ldots\ldots\ldots (2)$$
$$Na_2O + CO_2 = Na_2CO_3 + \text{heat}. \quad (3)$$
$$2H + O = H_2O + \text{heat} \quad \ldots\ldots\ldots (4)$$
$$Na_2O + H_2O = 2\,NaOH + \text{heat} \quad . (5)$$

Thus we see that the sodium peroxide gives up one atom of oxygen which unites immediately with the carbon of the coal to form carbon dioxide with the liberation of heat. The remaining sodium monoxide (Na_2O) unites with the carbon dioxide to form sodium carbonate (Na_2CO_3) with the liberation of some heat, also with the combined water forming sodium hydrate (Na OH) with the liberation of heat. What hydrogen there may be in the coal unites with oxygen liberated from the sodium peroxide to form water and liberates heat, the water thus formed unites with the sodium monoxide as explained above.

It will be noted that there are some chemical changes (equations 3 and 5) that give off heat which do not take place when the coal is burned in air; it is necessary, therefore, to make correction for these. It has been carefully determined by the maker of the instrument that only 73 per cent of the heat liberated by the chemical changes as described above is due to the coal itself, so the total B.t.u. liberated during combustion should be multiplied by 0.73 to give the heat value of the coal alone.

There are other corrections, also, which must be considered for accurate determinations. It takes a certain amount of heat to raise the temperature of the ash from the initial to the final temperature, which, naturally, would lower the final temperature.

The combined water unites with the sodium monoxide, giving too high a reading, and the heat due to the fuse must be taken into account.

In the present case it was found that the combined error created by these influences was an increase in temperature of 0.1854 deg. F. Subtracting this from the maximum temperature rise gives $4.59 - 0.1854 = 4.4046$ deg. F as the corrected temperature rise.

Since the sample taken was 0.5 gram, 1 gram would raise the temperature $2 \times 4.4046 = 8.8092$ or 8.81 deg F.

$8.81 \times 0.73 = 6.43$ deg. F. = rise of temperature due to combustion of coal alone.

The water equivalent of the material used in the instrument was given by the manufacturer as 135 grams. The water used in the calorimeter was 2 liters or 2000 grams, therefore the equivalent of 2135 grams of water has been raised 6.43 deg. F. by the combustion of 1 gr. coal.

Since 1 gr. of coal raises 2135 gr. of water 6.43 deg. F., 1 lb. of coal would raise 2135 lb. of water 6.43 deg. F., therefore, to get the B.t.u. value per pound of coal, multiply 6.43 by 2135, giving 13,728 B.t.u.

To simplify calculations the manufacture of the instrument furnishes a constant by which to multiply the rise in temperature to give the B.t.u. value of the coal. This constant can safely be used as the percentage of error would be small, depending on the combined water and ash in the coal. The above method is given, however, to show how the constant has been derived.

The precautions to be taken when making a calorimetric test are to secure a thoroughly dry sample, make accurate weighings, have initial temperature of the water slightly below or at atmospheric temperature, keep the water well stirred and be careful in reading the thermometer.

Sulphur Determination

AFTER the coal has been burned in the cartridge, the bottom can be removed and the contents taken out. It will be found in a hard lump, which can readily be removed; what small particles adhere to the shell are easily washed out; distilled water should be used, and the washings kept in a beaker in which the cartridge can be dissolved.

This solution is alkaline. To it is added enough hydrochloric acid (H Cl) to make it acid and then filtered to remove foreign particles which are thoroughly washed. The filtrate is boiled and barium chloride ($BaCl_2$) is added and a precipitate of barium sulphate ($BaSO_4$) will be formed if sulphur is contained in the coal.

To find the percentage of sulphur the solution containing the barium sulphate is passed through an ashless filter, leaving the precipitate in the filter which is put into a crucible and burned, leaving only the dry barium sulphate which is then weighed.

The atomic weight of barium is 137.4; that of sulphur, 32.06; of oxygen, 16; the molecular weight of the barium sulphate ($BaSO_4$) is $137.4 + 32.06 + (4 \times 16) = 233.46$, and the weight of the sulphur in the 0.5 gram of coal used would be $\frac{32.06}{233.46}$ or 0.1373 times the weight of the barium sulphate left in the crucible. Knowing the weight of the sulphur and the sample from which it was taken, the percentage is readily calculated.

For example, suppose the sample of coal weighed 0.5 grams, as in the above case, and the weight of the barium sulphate was 0.0388 grams, then the percentage of sulphur in the coal would be

$$0.1373 \times \frac{.0388}{0.5} \times 100 = 1.06 \text{ per cent.}$$

Determination of sulphur from the residue left by a calorimeter test is rather awkward, in that so much sodium peroxide is used that it requires a large amount of hydrochloric acid to make the solution acid. A more rapid method is to use 0.5 gram of dried and pulverized coal; put it in a crucible and add 5 grams of sodium peroxide; mix these thoroughly with a fine wire, being careful that no coal adheres to the wire when it is removed, heat the mixture over a gas flame and it will immediately fuse; when this has occurred, remove the flame, dissolve the residue in distilled water, acidulate with hydrochloric acid, filter out earthy matter and boil; then add 15 cubic centimeters of a saturated solution of barium chloride, which will precipitate the barium sulphate and the percentage of sulphur can be determined as in the former method.

With a little practice in the use of the calorimeter, the heat value of the coal and the percentage of sulphur, using the latter method, can readily be made in an hour to an hour and a half. The results obtained depend, of course, upon the accuracy with which the work has been done. A variation of less than 1 per cent in calorimeter determinations is considered sufficiently accurate for power plant practice.

JOHN U. HIGINBOTHAM, formerly assistant treasurer of the National Biscuit Company, has associated himself in a similar capacity with the Detroit Lubricator Company, Detroit, Mich.

Questions Answered and For Answer

Expert Help When In Trouble. If You Want Quick Answer Enclose a Stamp

Engineer's License in Massachusetts

I SHOULD like suggestions which will help me to pass an examination for engineer's license in Massachusetts. S. McM.

A. It is not an easy task to make a thoroughly satisfactory answer to the question asked. The answer must be general, whereas every man usually requires some special assistance. But if the reader will take what follows with that understanding, perhaps he will find something worth while.

I take it that the questioner desires a third-class engineer's license, and shall work from that assumption. This license gives a man privilege to have charge of a plant, the engine of which is 50-hp. or less, and to operate under another engineer any plant in which there is no engine exceeding 150-hp. It will at once be seen that the latter category covers some very important plants.

There is one illusion that is very generally held by engineers that I would like to dispel at the outset. It seems to be common belief that if one can only get hold of a set of questions asked by examiners, and the correct answers, that his chances are very good for securing the license. Just put away any such thoughts. The examiner is mainly interested in whether the applicant is a safe man. To determine this, he must take into consideration: Experience, appearance, and reputation of the man before him, as well as his ability to understand the principles underlying the operation of the apparatus to be found in the power plant. The questions are asked with this one purpose. Now, the examiner knows that a parrot would not be a safe operator, no matter how glibly he might answer a set of questions. So the examiner is continually seeking a new way to ask an old question. But if the man before him really understands the underlying principles, he has nothing to fear. A set of questions has one, and only one, value—that's to serve as a sort of review.

So much for what not to do. Now let us look at what should be done. In the first place, a knowledge of the language sufficient to write a good letter and to fill out blanks, etc., correctly is without doubt an asset. Nearly every town of importance now has a night school, and therefore any obstacle in this line is easily overcome. At the same time, one could take up arithmetic and possibly algebra. Algebra is a great help to any engineer and a certain amount of arithmetic is absolutely essential. Here are some things necessary to know how to compute: circumference of circle (for safety of boilers, flywheel, changes in governor, etc.); area of circle (pressure on piston, cylinder head, boiler head, bolts and stays); surface of cylinder (tube surface, boiler heating surface); volume of cylinder, percentage, square root, etc.

The book of boiler rules should be studied and the applicant should be familiar with all laws and rules relating to plants covered by the license desired. Especial care should be bestowed on parts relating to safety valves, fusible plugs, and discussion of various styles of joints.

Below are listed some of the things which may be looked into with advantage. These are to be considered as suggestions rather than as a complete list.

Boilers

FAMILIARITY with return tubular, Manning, and one or two types of water tube.

Ability to compute single and double riveted lap joints as outlined in rule book.

Scale, cause, cure, prevention; oil, source, danger, how prevented; foaming, cause, cure; priming, cause and cure; boiler repairs—calking, retubing, patching; boiler settings, means of suspension, allowance for expansion, height of bridge wall, protection for flush front; water column, blowoff pipe, and feed pipe requirements (by rule all pipes must be screwed into a boiler a certain distance); care in use of mechanical cleaners; setting of safety valve, both for blowing off and the "blow back" or "pop."

Pumps

PRINCIPLE of action of one make of simplex pump; setting valves of duplex; characteristics of feed pump, tank pump, hydraulic pump; pump valves—requirements for various services; pump troubles; how a pump "lifts" water through the suction pipe; how a condenser "lifts" water; action of siphon.

The injector, principle of action, especially the explanation of its ability to force water against a higher pressure. Learn various matters to look out for in piping up and in care. Injector troubles, causes and cure.

Engines

SET valves of plain slide valve, riding cutoff, and Corliss; point out differences between throttling and automatic cutoff engines; piston valves, valves with pressure plate, balanced valves; single acting engines, compound engines; names of various parts of engines; reversing engines—Stephenson link; 4-valve, Corliss with semi-rotary valves, Brown with gridiron valves; Fitchburg with piston valves, Putnam with poppet valves; find other engines for illustrations of above differences; high-speed engines, shaft governors, centrifugal and inertia. Learn what it is possible to learn of distinctions and traits of above. Learn what things will cause a shaft governor to operate poorly or not at all; also what will render Corliss governor inoperative. Learn how to make adjustments—taking up brasses, scraping and babiting, shimming, centering of piston, care of piston rings, cylinder, valve seats, finding and adjustment of clearance, finding of "centers" by tramming.

Take indicator cards and compute horsepower. Compute rim speed of various flywheels and determine if they are running within safe limits. Compute pressure on cylinder head and see if studs are strong enough.

Feed Water Heaters

CLOSED and open. Applicant should be somewhat familiar with at least one make of each type. Tests for leaky closed heater, danger from leaks; dangers to guard against with open heater.

Steam traps, use, care, piping. Return traps, operation, care, piping. Applicant should be familiar with at least one make of each.

Get the habit of observing things and reasoning about them. Keep asking yourself, why? If you can't find the answer, ask someone else. It is surprising to see the number of things we daily handle and know nothing about. How many engineers could tell offhand why a duplex pump has one long and one short lever? We have even seen an old engineer set up a tank pump to feed a boiler and wonder why it didn't work. He had handled feed pumps for years, but evidently the fact that the water pistons were smaller in diameter than the steam pistons had escaped his notice. Learn to see things about you and understand the reasons for their being so.

And learn to attack mathematical problems without fear. "Familiarity breeds contempt." So get familiar. If you can find no other way, make problems upon the plant where you work. See if the feed pumps are the right size for the work. Learn the gain by use of feed-water heater. Compute the heating surface of the boilers, the evaporation, the safe pressure, the required size of safety valve, the expansion of the boiler in longitudinal direction, velocity of water in feed pipe, of steam in pipe to engine, and a hundred similar problems that will come to the mind of the active man in fire room or engine room.

Last, but not least, get experience in different plants. Visiting other plants is of much value, but actually working in a strange plant brings out many things the visitor will never see.

Rheostat Calculations

HOW many feet and what size of 18 per cent German silver wire will I need to construct a unit to be worked on 110-volt mains? H. S. M.

A. Your question does not give sufficient data for a perfectly definite answer. You do not state what amount of current you wish to carry through your resistance, nor whether you wish to use up, in this resistance, the entire 110 volts.

There is always more or less variation in German Silver wire, even the same percentage of nickel, so that allowance must be made to get on the safe side.

Assuming that you want to use all of the 110 volts on the resistance wire, it would work out for 2 cases as follows:

For a No. 14 wire in bare coils, the safe current is 34.5 amp. The resistance necessary would then be 110 divided by 34.5, or 3.19 ohms. It takes about 21.2 ft. for an ohm, so that the length required would be 3.19 multiplied by 21.2, or 67.5 ft.

Taking a No. 20 wire, it will be safe to carry 12.1 amp. The resistance required would then be, 110 divided by 12.1, or 9.1 ohms; and the wire requires 5¼ ft. per ohm, or a total of 47.8 ft.

How Will Pump Work?

BOTH pistons of a duplex pump are in the center of their travel, both head end steam ports are half open owing to incorrect valve setting, how will the pump work? R. S.

A. In the ordinary duplex pump, properly adjusted, there is no motion of the valve itself, when the pistons are in center of the cylinders. The pistons may be assumed to be moving in the same or opposite directions. In either case, at this central point of the pistons, the valves are standing at the end of their travel. Taking into account that one valve arm imparts direct, and the other indirect motion, it is readily apparent that one of the valves must move in one direction, the other in the opposite direction. Since both are in their extreme positions on the same ends of the valve chamber, it is evident that one port of one cylinder will never be uncovered—consequently the pump jams or stops.

Trouble with Cylinder Oil.

AT the plant where I am employed there is an engine cylinder 24 by 36 in. with a rocker valve in the bottom of the cylinder and with 120 lb. steam pressure. Now, the cylinder oil settles on the inside surface of the cylinder like soot. The oil we use is known as "Capitol." I will send a sample of the oil scraped out of the cylinder. Will you please advise the cause and remedy? L. W.

A. After a careful examination of the small sample of gum from the inside of the cylinder, I would say that you have secured a barrel of oil which has not been properly refined, and should return it to the dealer from whom you purchased it.

You do not state how long you have been having the trouble. After securing a fresh barrel of the oil you might not experience further difficulties. I would not recommend Capitol cylinder oil, however, for use in a cylinder using 120 lb. steam, at all, if it is the Capitol cylinder oil put out by the S. O. Co., and I assume it is.

It would be more economical, in the long run, to use Wm. C. Robinson & Son Co.'s No. 6 cylinder oil, or one of Vacuum Oil Co.'s products. You would experience no such trouble with these oils, I am sure.

If it happened to be more convenient to buy S. O. Co.'s oils, I would advise you to secure its Economy Brand cylinder oil.

Frederick E. Dobbs.

ANOTHER TRIUMPH OF POWER in its service to mankind is shown in the anthracite coal mines of Pennsylvania. In 1902 mechanical horsepower in use was 354,000, and in 1911, 672,000, the power nearly doubling in that time. Most of this increase was for transportation below ground, in working more remote veins, and it is quite certain that if it were not for the availability of mechanical power and the electric locomotive, the anthracite coal mines would be nearly shut down.

During the period mentioned, the number of horses and mules, which was largely the earlier form of power for haulage, actually decreased, while the number of electric locomotives increased from 53 to 635, and steam locomotives from 373 to 573. For short hauls and steep grades, the mine mule still holds his own; but for long hauls and moderate grades, steam and electricity are now almost universal.

Effect of Removing Back Pressure

KINDLY inform me what the saving would be on a tandem compound engine, 17 by 28 by 36-in. stroke, running 120 r.p.m., if the 3½ lb. back pressure that the low pressure now has should be taken off, steam pressure, 120 lb. H. M. de R.

A. In the engine that you mention, the high-pressure cylinder, 17 in., would have an area of 227 sq. in., and the low- pressure cylinder, 28 in., an area of 615.8 sq. in. The ratio of cylinders will then be, $615.8 \div 227 = 2.72$. A total expansion in the engine, assuming that it is noncondensing, with 3.5 lb. back pressure, would be 135 (the boiler pressure absolute) divided by 18.5, or 7.31. Dividing this by the ratio of cylinders, 2.72, gives 2.68, the expansion in the high-pressure cylinder.

From a table of mean pressure ratios as given in Practical Engineer data sheets, for an expansion of 2.68, the ratio of mean forward pressure to initial pressure is 0.72, and $135 \times 0.72 = 97.2$ as the mean forward pressure in the high-pressure cylinder. The receiver pressure, which is the back pressure in the high-pressure cylinder, will be, $135 \div 2.68 = 50.4$. Subtracting this from the mean forward pressure, gives 46.8 as the mean effective pressure in the high-pressure cylinder.

The horsepower will then be,

$$\frac{46.8 \times 3 \times 227 \times 120 \times 2}{33{,}000} = 232 \text{ hp.}$$

For the ratio of expansion of 2.72, tables give the ratio of 0.715, between the mean forward pressure and initial. The initial pressure in the low-pressure cylinder is the receiver pressure, or 50.4 lb. This mutiplied by 0.715 gives 36 lb. as the mean forward pressure. Subtracting from this 18.5, the back pressure, gives 17.5 as the mean effective pressure. The horsepower will then be,

$$\frac{17.5 \times 3 \times 615.8 \times 120 \times 2}{33{,}000} = 236 \text{ hp.}$$

To find the effect of removing the back pressure, we would substitute 15 lb. as the back pressure in place of 18.5. This would increase the mean effective pressure 3.5 lb., or make it 21 lb. The low-pressure horsepower would then be $236 \div 17.5 \times 21 = 283$ hp., or an increase of 47 hp. in the low-pressure cylinder. A. L. R.

Overcoming Effect of Lost Vacuum

PLEASE give the answer to the following questions:

If you were carrying 28 in. of vacuum and lost it, how much would you have to increase the boiler pressure to carry the same load and cutoff at one-quarter stroke, the same as before losing the vacuum?

Will you also give me a formula for working such a problem at various cutoff as well as different vacuums? J. W. D.

A. The mean forward pressure per one pound absolute initial pressure, with a 5 per cent clearance and 25 per cent cutoff, is 0.626 lb.

Assuming the initial pressure to be 100 lb. gage, which would be 115 lb. absolute, the mean forward pressure would be, $115 \times 0.626 = 71.99$ lb. absolute.

A condensing engine with 28 in. of vacuum, has an absolute back pressure of about one pound, and a noncondensing engine, of 15 lb., making a difference of 14 lb. to the back pressure when condensing and noncondensing

Then, $71.99 - 14 = 57.99$, the mean forward pressure when condensing; and the absolute initial pressure equals $57.99 \div 0.626 = 92$ lb. +. Gage pressure will be $92 - 15 = 77$ lb. Then the difference between 77 and 100, which is 23 lb., is the required increase in steam pressure, for the conditions which you state in your problem. N. G. M.

Lap of Double Eccentric Engine

ON a 17 by 22-in. nonreleasing 4-valve engine with 2 eccentrics should the steam valves have positive or negative lap? How much? The engine is a Corliss noncondensing with flywheel governor that moves the eccentric across the shaft, changing travel but not lead. It has no wristplates and was built by the Atlas Engine Works; speed, 125 r.p.m.

One writer says for 2-eccentric releasing gear engine use ½ port opening, another says use ⅛ in. lap. I don't understand how an engine can work if it takes steam on both sides of the piston at once (with the valve gear central).

There is also the same difference of opinion regarding the exhaust valves. L. B.

A. Before answering this question I deemed it advisable to communicate with the manufacturer of the Atlas engine in regard to the proper method of setting the valves, and can advise you that the following is the proper way to set the valves on the Atlas 4-valve engine:

First, loosen the governor springs and block out the governor weights against the least travel stops. Place the crank on the front end center and adjust the steam eccentric rod until the valve at the crank end of the cylinder has 1/32-in. positive lap. Then place the crank on the back center and adjust the steam parallel rod until the valve at the head end shows 1/32-in. lap.

You will see that the distance between the centers of the heads on this rod is somewhat less than the distance between the centers of the valve bores, thereby causing the levers to travel a greater distance beyond the vertical center line towards the center of the cylinder, than towards the end of the cylinder. This is done to secure a quicker opening and closing of the valve.

To set the exhaust valves turn the engine over until the piston is near the crank end of the cylinder at a point where compression is desired to commence, then adjust the exhaust eccentric rod until the valve in the front head is just on the point of closing. Then turn the engine over until the piston is near the head end of the cylinder where compression is desired to commence and adjust the exhaust parallel rod until the valve in the head end is just on the point of closing.

For convenience in setting the valves, lines will be found in the valve bores and on the end of the valves corresponding to the cutting off edge of the valve. After setting the governor springs must be tightened up to their original tension which will give the proper speed to the engine.

It is advisable, however, to check up the setting of the valves by the aid of the indicator to get the fine adjustment. From the foregoing it will be seen that the steam valves are set with 1/32-in. positive lap with the crank on the center, and, as the exhaust valves are set by the amount of compression desired, there will be positive lap on the exhaust valves, the amount depending on the compression desired. Note that the governor is blocked out to the running position before the valve is set. J. C. Hawkins.

Problems For Discussion By Readers

What Would You Do If You Had These Conditions To Meet?

Lubricating Problem

AT the plant where I work we have a unit lubricating system. The reservoir is above the highest sight feed glass and has a condenser chamber about 5 ft. high. The sight feeds will not feed regularly. We can sit there and in a few hours they will slow down and stop feeding. I should be very glad if some one would suggest a remedy for this trouble.

A. W. C.

Gage Glass Problem; Metallic Packing; Numbering Boilers, etc.

I WISH to thank T. C. R. for his efforts to explain the broken gage glass problem which I submitted. As the gage glass fittings are placed on the body of the Leblanc condenser exactly as a glass is placed on a water column, I hardly think a sketch necessary. These glasses were not removed to be cleaned, but were cleaned by removing the plug in the top fitting and as the strain of removing the plug would be at right angle to the fitting I don't see how the fitting could be thrown out of line as suggested. I would be glad to hear further argument on this subject.

In reply to Mr. Mason's question on metallic packing for the water end piston rods, of duplex pumps, I have seen it tried on both hot and cold water old and new rods and while I was not personally making the test my observation was that the only way to keep them from leaking badly was to keep a man close by at all times with a wrench.

My answers to W. K. M.'s questions in the April 1 issue would be:

1. The time required to warm up an engine before putting it in service would depend on the size of the engine and how fast it was turned over during the warming up process. We consider 15 min. long enough to warm up a 300-hp. compound engine.

2. I don't know if there is any standard for numbering boilers, but I think where practicable they should be numbered from left to right. In some cases the battery is not complete with a space for future installations on the left. I think in view of the fact that the insurance company is likely to have a record by number of inspections extending over a number of years, it would be impossible to change the number of old boilers on installing a new one; therefore, you would have your boilers numbered like 6, 1, 2, 3, 4, 5, which to my mind would look worse than 6, 5, 4, 3, 2, 1.

3. The way I would distinguish the polarity of the brushes of a compound-wound d.c. generator would be to test the direction of current with a compass, as explained in Practical Engineer for December, 1912, page 1232.

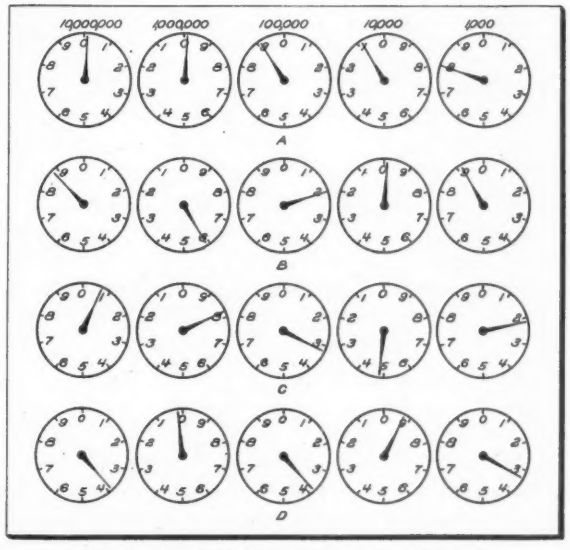
4. As I understand a Tirrell regulator, it regulates the exciter voltage at the required strength by alternately "cutting out" and "cutting in" the exciter field rheostat. This is done so fast that the exciter voltage is held practically constant much the same as you can make an incandescent lamp burn dim by turning it off and on alternately.

The more resistance is inserted in the a.c. generator field the higher the exciter voltage must be to force the required amount of current through the field. This is accomplished by the regulator contacts remaining in the "cut in" position for a greater length of time.

E. C. B.

Reading Wattmeters

KINDLY give me some information in regard to reading recording meters and telling if the hands are misplaced or not. How can I tell how much they are misplaced behind or ahead of where they should be?



METER DIALS OF FOUR SEPARATE READINGS

The following readings have been taken from the Thompson recording wattmeter for showing the amount of current used by a customer; how can I tell how to charge a customer?

I should like an example showing how the integrating wattmeter is read and how to charge a customer for the current he has used. The former reading of the integrating wattmeter is 373. J. I.

THE WATER USED in mixing concrete should be free from oil, acid, strong alkalies and vegetable matter.—Christie.

THE MAN who will not save as he goes keeps his nose to the grindstone.

PRACTICAL ENGINEER

Trade-mark reg. U. S. Pat. Office.

PUBLISHED ON THE FIRST AND FIFTEENTH OF EACH MONTH
At 537 So. Dearborn Street, Chicago, Ill., by the
TECHNICAL PUBLISHING CO.
New York, 150 Nassau St. Cleveland, Am. Trust Bldg.

Notify us at once of any change of address, giving the old and the new address, so that your paper may always reach you promptly.

Copyright 1912 by Technical Publishing Co.

Entered as second class matter May 1, 1908, at the Post Office at Chicago, Illinois, under the Act of March 3, 1879.

Circulation of this issue, 22,500.

CONTENTS

Light, Heat and Power Plant. Illustrated....629
Measuring Steam Consumption. Illustrated....633
Low-Pressure Heating Boilers. Illustrated....636
Estimating Fuel Required. By J. P. Lisk....637
Misdirected Energy. By I. H. P....638
Provisions of the New Jersey State License Law....639
Report of Committee on Prime Movers. Illustrated....640
Preserving Poles and Posts....641
Approximate Cost of Building Wiring....642
Boiler Explosion on Steam Barge "E. M. Peck" at Racine, Wis. By Geo. H. Wallace. Illustrated....644
Correspondence of an Old Engineer and His Son....648
Foreign Power Plant Development. By J. H. Blakey. Illustrated....650
Letters Direct from the Plant: Finding Radius of Flange. Strength of Pipe. Metallic Packing. Defective Valves. Some Easily Remembered Instructions for Shaft Governors. Boiler Formulas to Be Memorized. Condenser Operation. Metallic Packing for Pumps. Illustrated....651
Successful Kinks from the Plant: Improvised Gasket; Tool for Cutting Bolt Holes. On the Center. Practical Pointers for Steam Plants. Power Plant Chemistry. Illustrated....656
Questions Answered and for Answer: Engineer's License in Massachusetts. Trouble with Cylinder Oil. Rheostat Calculations. How Will Pump Work? Effect of Lost Vacuum. Lap of Double Eccentric Engine. Illustrated..658
Problems for Discussion by Readers: Lubricating Problem. Gage Glass Problem; Metallic Packing; Reading Wattmeters. Illustrated....661
Editorial: Saving Water Powers and Fuel. The Plant Tickler....662
Indiana Engineers in Convention. Illustrated....663
Ohio Engineers at Toledo. Illustrated....664
Knickerbocker Engineers....667
Recording Differential Pressure Gage. Illustrated....669
Starrett Ratchet Wrench for Engineers....670
News Notes....671
Catalog Notes....672

SAVING WATER POWERS—AND FUEL

While all agree that the benefit of the great resources of Nature should be used for the good of all, there is much question as to whether a policy which holds back the development of water powers is a saving or a waste. The case is different from that of a coal mine or a timber tract where a store of fuel or lumber saved is available for future use. In a water power, the energy which wastes itself in tumbling over rocks and surging in eddies is gone for good unless harnessed as it passes. Tomorrow's stream may turn tomorrow's wheels, but today's waters may only be used today. Every horsepower which dashes unchecked over a cliff, might mean, if utilized, either the relief of an equivalent of human labor now, or the preservation of a store of coal for future needs.

In the economy of the world, it would seem the part of common sense to encourage as rapid development of water powers as possible, even if those who furnish enterprise and capital do reap large rewards for a time, with provision for future control of power rates such that the final benefit shall be distributed equitably. A well installed hydraulic development suffers little in depreciation except in the machinery, hence in the interest of conservation we can well afford to make such development work attractive to those who are ready to undertake it, rather than to adopt a policy of repression or impose hardships which may cause delay. Eight per cent, only, of the available water powers are now at work, and much not now used is controlled by the government in public domains or navigable streams. Public opinion must be the force to set these undeveloped powers free by pressure on public officials to adopt a course of encouragement to capital seeking such investment.

THE PLANT TICKLER

"Upstairs" the tickler is in use in nearly every establishment to insure that attention is given to details at the proper time, without the Boss burdening his memory, when new material should arrive; when a shipment is to be made; when a note is due to be paid or collected,—in a hundred ways the tickler relieves the memory and guards against oversight. Surely the chief with the numberless details which he must watch needs a tickler as much as anybody in the office can.

It's not a matter of red tape either. A small card index, a memorandum desk pad, a pocket diary, even a large wall calendar with space around the figures for making memoranda will help greatly to systematize plant operation. Renewing packings, indicating the engine, cleaning boilers, ordering supplies, grinding valves, inspection of bearings, these and other details may be committed to the care of the tickler with much saving of mental strain and improvement in regularity of operating.

In all except the smallest plants, more and more the engineer must become and is becoming an operating manager with the duty of detailing routine to others. To make certain that his ideas are carried out necessitates that reports and inspections be made, and in this the tickler becomes an automatic memory.

One rigid rule is, however, essential. Put everything down at the time you make a decision, and consult the tickler each morning for the work of that day. Otherwise one might as well keep on the haphazard, do-it-when-you-happen-to-think-of-it way. System begets efficiency, and efficiency is what the world pays for.

INDIANA ENGINEERS IN CONVENTION

The License Law and State Employment Bureau Principal Topics of Discussion

THE ninth annual state convention of the National Association of Steam Engineers, held at Terre Haute, Indiana, June 4-6, owes much of its success to the enthusiastic efforts of the local members. Whether by threat or kindly persuasion, they induced the weather man to serve up 3 ideal days and the hospitality of the town did the rest. The general verdict of both members and exhibitors was that it was the best convention the state organization had ever held.

Mention should be made in the beginning of the work of the local members that brought about the real success of this convention. Superintendents, managers and engineers in all directions received special invitations to attend and the responses were most gratifying.

The meeting opened June 4, at 1:30 p.m. with addresses of welcome by Mayor Louis Gerhardt and H. R. Ihrie, secretary of the Terre Haute Commercial Club. National President John McGrath and Secretary F. W. Raven responded in behalf of the visiting engineers.

The opening was in the nature of a regular meeting of the Local No. 8 Association of Terre Haute and was taken up by the usual routine work. Prof. F. C. Wagner of the Rose Polytechnic Institute was initiated and expressed his pleasure in becoming affiliated for the first time with an organization of this nature. The initiation was conducted by national officers John F. McGrath, F. W. Raven, and Charles W. Naylor, after which Prof. Wagner was presented with a certificate of membership.

The morning of Thursday, June 5 was occupied with reports from the various committees. That which particularly interested the members was the report of E. G. Heeger, chairman of the License Law Committee. Mr. Heeger was instructed by the state association at the last convention to take up the matter of a license bill and to secure the co-operation of the various state associations, and other engineers. He stated that he had received reports from every association, giving assurance that they would do all in their power to secure the passage of the bill but from the non-members very little response was received.

It seems that in spite of all the assurances that were given from the associations the bill was defeated largely through lack of interest.

It was the policy of the committee at Indianapolis, that had charge of this bill, not to advertise but to work quietly. Mr. Heeger thought this was a wrong move; that the bill should be as satisfactory to manufacturers as to engineers and that it should have the co-operation of every manufacturer and engineer in the state.

An invitation was extended by Mayor Gerhardt for the convention to attend the opening of the German club in its new quarters which many of the members accepted.

INDIANA DELEGATES AT TERRE HAUTE

The local committee had arranged to have the delegates visit plants of interest in Terre Haute and at 1:30 a special car carried them to the water works where they were met by Dow R. Gwinn, the president, and W. E. Taylor, Chief Engineer. An interesting comparison was shown between the old style Clapp and Jones engines of the vintage of 1872 and the modern Allis-Chalmers engines; also between the old iron return-tubular boilers of 1880 and the new Stirling boilers. The fact that both these old time boilers and engines were still serviceable was a source of wonder to the visitors as many were of a generation that knew them only as things of history.

The delegates were next taken to the Terre Haute, Indiana & Eastern Light & Street Car Co.—another up-to-date power plant furnishing light and power to Brazil and Clinton—with a transmission of more than one hundred miles; here Harvey Smith, the chief engineer, did the honors.

A visit to the American Hominy Co., where T. Sanders, the chief engineer, was host completed the

day, and the members, visiting engineers and their friends met in the exhibit hall in the evening to listen to an impromptu illustrated talk by Prof. Wagner on steam turbines.

Friday morning, June 6, was devoted to reports of various committees and communications from members who were unable to attend. A letter received from E. H. Kearney, of Boston, expressed his regrets at not being able to attend and the hope that the national body would see fit to spend $10,000 for educational purposes the coming year.

Mr. Naylor gave an encouraging and pleasing talk in which he urged all members to read the magazines devoted to the power plant field and not to overlook the advertising pages, as these pages would prove instructive and valuable.

National Secretary F. W. Raven followed and spoke along the same lines, supporting Mr. Naylor's remarks about reading the magazines. He also spoke about the members who were always on deck for the good things but who were not any too conspicuous when there was real work to do.

The question of a state employment bureau was brought up and referred to a committee, the idea being to have a classification of all engineers, their ratings, etc., and any desiring a change of location or an opportunity to better themselves would have the means of getting in touch with employers. A list of power plants would be kept and the positions each one afforded.

I. Baldus of the Indianapolis Chamber of Commerce extended an invitation to hold the next convention at Indianapolis, which on vote was accepted, the date to be decided later by the Exhibitors Association.

The following officers were chosen for the ensuing year: President, Geo. R. Fields; Vice-president, Louis Menke; Secretary, Albert Franke; Treasurer, Albert Arens; State Deputy, E. S. Heeger.

The afternoon was devoted to a boat ride and fish fry.

IN THE EXHIBIT HALL

The Central States Exhibitors Association arranged attractive displays in the basement of the Pythian Temple, where they entertained the visiting engineers.

The Wm. Powell Co., of Cincinnati, Ohio, showed its White Star reversible nickel disc valve, Cyclone blow-off, Union disc and Model Star, together with lubricators and specialties. Charles Cullen was busy as representative and as secretary of the Exhibitors Association.

Greene, Tweed & Co., New York, had a fine display of Palmetto packing, showing a full line of square and round braids and twists; and Manhattan packing, a flax packing for the water end of pumps. A. J. Richardson was on duty.

Dearborn Chemical Co., Chicago, Ill., gave out literature on Dearborn feed water treatment and lubrication problems, and special souvenirs in the shape of steel pocket tapes and perfume to the ladies. E. T. Payne and J. F. McDonnell presided.

The V. D. Anderson Co., of Cleveland, had on display the Model D steam trap, and explained the value of the water gage, bypass, air valve, blowoff valve and sediment strainer. Joseph H. Meyer was in charge.

The C. E. Squires Co., Cleveland, showed a working model of its improved steam trap. T. P. Gibson explained its operation.

The United States Graphite Co., of Saginaw, Mich., W. G. Thompson in charge, displayed samples of Mexican graphite greases, including cable grease, machinery lubricants, etc., also boiler graphite and scale it had removed.

Albany Lubricating Co., New York City, A. J. Olson, urged the visitors to join the "Don't Worry" club by using Albany grease. A full line of samples was shown.

Hawk-Eye Compound Co. of Chicago distributed souvenir watch guards and literature describing the merits of its compound. The exhibit was in charge of I. E. Cook.

Garlock Packing Co. of Palmyra, N. Y. showed an attractive display of cut gaskets from Garlock No. 900 sheet. Printed matter was distributed by A. C. Hirschman, and J. E. Hillerman.

The Lunkenheimer Co., Cincinnati, had a very attractive exhibit, showing oil cups and pumps, check valves and a complete line of literature describing its products. This exhibit was in charge of C. Strong.

Crandall Packing Co. of Palmyra, N. Y. showed various forms of packing and steam traps. Literature was distributed by F. M. Wheeler.

Crane Co., A. M. Barnes and R. E. Burget in charge, had a large exhibit, showing the Cranetilt Trap, operated by compressed air, and also drain traps and direct return traps in operation and in actual working sizes; also a full line of valves, pipe bends, etc.

H. Mueller Mfg. Co., Decatur, Ill., had a good exhibit of reducing and regulating valves. E. A. Mann was in charge.

Cling-Surface Co., Buffalo, N. Y., was represented by F. J. Rhodes, who showed some interesting photographs and circulars regarding Cling-Surface treatment for belts.

Jenkins Bros., Chicago, A. T. Arens in charge, had a fine display of valves and Jenarco and Palmetto packing.

Freitag Weinhard Co., Terre Haute, exhibited asbestos packing, pipe coverings and Noark fuse devices, the merits of which were explained by E. L. Moore, assisted by W. H. Kading and C. E. Wehr of the H. W. Johns-Manville Co.

Terre Haute Oil & Coal Co., Terre Haute, E. B. Smith in charge, showed illuminating and lubricating oils, greases, paints, varnishes, etc., and a large line of specialties.

Osborne Valve & Joint Co., Chicago, distributed literature showing the merits of NoKut valves and exhibited a valve, cut to show its construction. W. L. Osborne was the representative.

OHIO ENGINEERS AT TOLEDO

16th Annual Ohio State Convention, June 11-13

EVERYTHING possible to make the stay of the engineers in Toledo pleasant, was arranged by the local committee, and even the weather man accommodated the delegates by furnishing the most delightful weather one could imagine.

The meetings of the State Association were held in the Memorial Building on the first floor, and were opened at 9:30 Wednesday morning, when Safety Director Mooney gave the address of welcome in place of Mayor Whitlock, and was responded to by John F. McGrath, national president.

C. H. Wirmel, the representative of Gov. Jas. M. Cox, chief examiner in the License & Inspection Department of Stationary Engineers in the State, also delivered an address at this meeting.

John D. Biggers, Secretary of the Toledo Commercial Club, gave an address and was followed by the annual report of president Thos. S. Synnett, which showed gratifying results of the past year's work, both in membership and finances.

The business session for the afternoon consisted of the report of the Credentials Committee, and the drafting of minor resolutions, which were referred to the various committees.

At the business meeting, Thursday morning, the association went on record as favoring the abolishment of license renewal fee of $2.00 a year, also the compulsory examination of stationary engineers, to make the State directly responsible for all boiler inspections, and favored making it compulsory for all boiler inspectors to pass an examination themselves. This last point is raised with the contention that a boiler examiner cannot possibly be competent unless he can pass the examination.

The resolutions committee offered a motion for the appointment of an educational committee for Ohio. This stand comes as a result of numerous boiler explosions during the past month, which they claim could have been avoided had competent men been employed.

Thursday afternoon was spent, by the delegates and friends, in a trolley ride around the beautiful Maumee Valley Belt Line, including a visit to the filtering plant, glass works, and other manufacturing plants.

The closing session of the convention was held Friday morning when the following officers were elected: President, J. F. Radigan of Cleveland; vice-

president, W. D. Spanger of Lima; secretary, Daniel E. Kennedy of Cincinnati; treasurer, John M. Wirmel of Cincinnati; state deputy, Jos. Howle of Cleveland; conductor, C. A. Knickenberger of Greenville; doorkeeper, H. L. Urmson of Alliance. Installation was conducted by F. W. Raven, assisted by Ed. Jacques.

The engineers selected Akron as the place of meeting for next year.

Friday afternoon was enjoyed, by all those who attended the convention, boat riding in the steamer, State of New York, on Lake Erie; the ship started at 1:30 and returned at 9:30 p.m. During the evenings, entertainments were given by the exhibitors on the second floor of Memorial Hall, consisting of vaudeville performances, orchestra music and songs by members of the Exhibitors' Association.

Exhibitors

PERHAPS the most attractive feature of the convention was the complete display of power plant apparatus and equipment, which was in charge of the Central States Exhibitors' Association, and occupied the entire second floor of Memorial Hall. Besides the active members of the Central States Exhibitors' Association, there were a large number of local firms which occupied booths and helped to make the convention the success that it was.

Jenkins Bros., with C. F. Beckwith and H. C. McLaughlin as representatives, occupied the corner booth with a display of standard gate valves, Jenarco packing, Jenkins 96 sheet, pump valves, Y blowoff valves, offset corner radiator valves, Diamond traps, etc.

The American Steam Gauge & Valve Mfg. Co. displayed the American Original Thompson indicator, reducing devices, pressure gages, dead weight testers, Amsler planimeter, etc. The exhibit was in charge of C. S. Kiessling.

The Diamond Power Specialty Co., of Detroit, demonstrated the use of its latest models of water cooled soot blowers for water tube boilers, also a complete line of blowers for all other makes of boilers. Models showing the operation and methods of installation were set up in the booth, which was in charge of A. Ray Houk.

The Dearborn Chemical Co. occupied a booth made beautiful with cut flowers, and distributed literature pertaining to Dearborn treatment of feed waters, and lubricating oils, the values of which were explained by Paul Payne, Dan Delaney, and E. H. Reihlman.

Power was represented by G. E. Andrews, A. R. Maujer, and Mr. Anness.

Shaw-Kendall Engineering Co., Toledo, exhibited piping for boilers and showed the value of oxy-acetylene for autogenous welding. W. L. Brown and R. M. Bellman were the attendants at the booth.

The Jefferson Union Co., Lexington, Mass., was represented by T. C. Millar, who displayed various sizes and styles of Jefferson unions, arranged in a most attractive manner.

Greene, Tweed & Co. displayed a full line of Palmetto and other packings for all purposes.

The Garlock Packing Co., represented by H. A. Carr, called the attention of visitors to Garlock 900 sheet packing for high-pressure work, red sheet No. 22 for low pressure and water, metallic packing, fibrous gaskets and pump valves, which covers the entire packing field.

Big Four Coal Co., Toledo, had samples of Scranton and Lehigh anthracite coal and Solvay coke on hand for examination by engineers who know coal values. The fuel expert in this booth was A. C. Hughes.

The V. D. Anderson Co., Cleveland, exhibited Model "D" Steam traps, the various parts which go to make up this trap, together with cross sections and models, the good points of which were brought out by Jos. H. Meyer.

The Crandall Packing Co., represented by J. M. Chapman and J. C. Stout, had a complete display of Crandall's line of packings, including a new product, the Rex Style 140 for Westinghouse air compressors and duplex pumps in tin can container, some of the old standbys, such as Lipp, Kymoi sheet, Rex sheet, Rex spool, Helios, etc.

The United States Graphite Co., Saginaw, Mich., makes Mexican boiler graphite, lubricating graphite and graphite greases, and W. G. Thompson was there to show how these products can be used in the power plant and displayed samples of scale removed with boiler graphite.

Toledo Fuel Co., was represented by Jas. W. Donovan.

The Wm. Powell Co. had a booth in charge of Chas. Cullen, who explained in the most pleasant manner the good points of Powell valves, including the White Star, the Union Disc, the Model Star, the Cyclone Blowoff, as well as oilers, lubricators and grease cups.

Nagle Electric Co., of Toledo, displayed fans, small motors, electric soldering irons and Pyrene fire extinguishers.

Practical Engineer was represented by R. E. Turner.

Nelson Valve Co., and the Yarnell-Waring Co., of Philadelphia, occupied a booth in charge of H. A. Hohmann and Carl Spero. They exhibited Nelson Valves, including gate, globe, brass, steel and iron, also the Caskey blowoff valve and Simplex hydraulic valves. A prominent article in this booth was the Lea recorder, used for measuring and recording the flow of water.

Kitts Manufacturing Co., Oswego, exhibited regulators, steam traps, safety water columns, hand regulators, and reducing valves, the good points of which were explained to inquirers by T. E. Synnett and B. H. Conkin.

Toledo Railway and Light Co. had on exhibit various gas and electrically operated appliances for domestic purposes. These were in charge of T. C. McKenzie and T. D. McMillen.

Hawk-Eye Compound Co. displayed a sample of its product and demonstrated its use by a compound feeder, G. A. Shaw being in charge.

W. I. Wilcox Co., Toledo, displayed a full line of mill supplies, packings, oil lubricators, gages, pipe coverings, etc., Fred Kirchmer being the representative.

FIG. 1. DELEGATES AND FRIENDS AT THE OHIO STATE CONVENTION

The Durabla Manufacturing Co. displayed gage glasses, packing and valve discs, the excellent qualities of which were explained by W. G. Werbeck.

White Star Refining Co., Detroit, had samples of Detroit greases to show to engineers, and their uses and advantages were put forth by Silas Cook.

Lagonda Manufacturing Co. had on display Lagonda products, including Multiple strainers, automatic cutoff valves, reseating machines, Weinland tube cleaners, condenser tube cleaners and tube cutters. How to care for various types of boilers with these tools was explained by F. H. Field, who represented the company.

Hardy & Dischinger Co., Toledo, exhibited a full line of engineers' supplies, including packings, gage glasses, packing tools, oils, greases, etc., in charge of A. G. Huebner, assisted by E. C. Read of the Peerless Rubber Mfg. Co.

Albany Lubricating Co. solicited members for the "Don't Worry" Club, all of whom are users of Albany grease. Samples of Albany grease, together with methods of feeding were shown by A. J. Olson.

J. E. T. Nicks, Toledo, showed a working model of the Downie Deep Well Pump, made by the Keystone Driller Co., also drilling machines, and centrifugal pumps on exhibit.

National Engineer was represented by R. W. Larkin.

The Metallic Packing & Mfg. Co., Elyria, was represented by Chas. G. Kellogg, who explained the advantages of Martell packings.

Harbison-Walker Refractories Co. showed forms of fire brick and results of fire tests on clays. H. G. Moore was in charge of the booth.

Standard Oil Co. displayed oils and greases for all purposes, laying particular emphasis upon Capital cylinder oil. Those representing the company were Wm. Deeg, D. A. Howey, S. L. Bissel, and Geo. A. Burke.

Buckeye Chemical Co., Detroit, was represented by W. M. Moore.

C. E. Squires Co., Cleveland, displayed a working model of the Genuine Squires Steam Trap, also parts and sections showing the excellent construction of this appliance. Mr. Gibson was the representative of the company.

Power Equipment Co., Toledo, was represented by Fred'k H. Mason. G. R. Lyon and Mr. Jones, who explained the excellent efficiency of complete power plants which they install, also displayed a working model of the Cooper Uniflow engine, and pointed out the good qualities of Fleming-Harrisburg engines, Stirling boilers, Cochrane heaters, etc.

Cleveland Mfg. & Supply Co. distributed literature on boiler compounds and displayed a Sims sight-feed boiler compound feeder. C. L. Strong represented the company.

H. W. Johns-Manville Co., represented by E. E. Skinner and C. E. Cox, displayed packings consisting of J-M Permanite, J-M Mogul, coil for steam, air, ammonia, etc., and Sea rings, also asbestos products for electrical purposes.

Geo. W. Lord Co. distributed literature showing the value of Lord's treatment, and how a boiler may be kept free from scale without injury to the tubes. F. M. Campfield was dispenser of information.

Fairbanks, Morse Co., Pump Department, exhibited a number of duplex pumps and distributed literature describing them. Wm. P. White was the representative.

Paragon Refining Co., Toledo, had one of the most attractive booths in the exhibit, in which were 31 working models of pumps and engines of every description since the invention of steam engines. These were operated with oils and greases made as petroleum products by the Paragon Refining Co. The company was represented by H. C. Walls, J. Arthur Schmitt, G. G. Fenneberg and J. H. Hausderfer.

The Anchor Packing Co., Detroit, represented by C. E. Briggs, and F. A. Dohl, displayed a line of metal and fibrous packing, consisting of Tauril sheet packing, Hydroil, Pahlow hose couplings and valves, valve discs, Ankorite packing, etc.

Cling-Surface Co., Buffalo, represented by O. J. Rhoades, explained how Cling-Surface is the life saver for belts, and distributed samples and literature upon the subject.

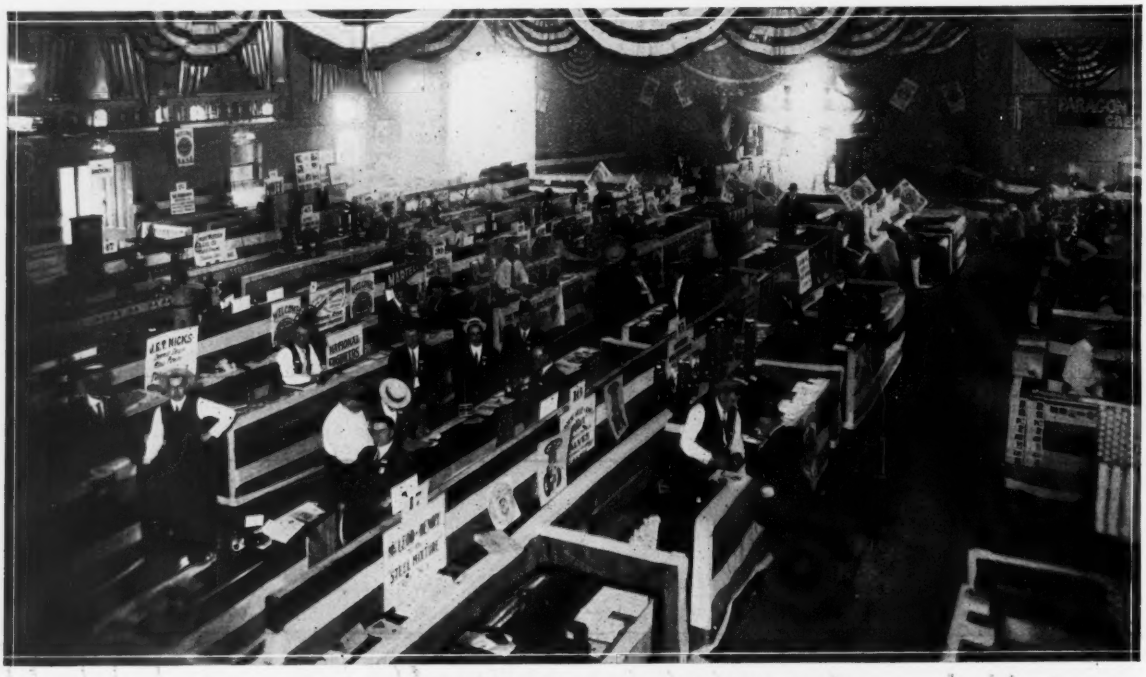


FIG. 2. MECHANICAL EXHIBIT IN MEMORIAL HALL, TOLEDO

McNaull Boiler Mfg. Co., Toledo, distributed literature describing its water tube boilers, C. W. Morgan being in charge of the booth.

International Correspondence Schools had on exhibit an interesting science library, written especially for engineers. L. T. Brown was present to give out circulars and answer questions in regard to this educational institution.

The Lunkenheimer Co., Cincinnati, displayed in an attractive booth brass specialties, including valves, oil pumps, hydrostatic lubricators, oil cups, whistles, injectors, gage glasses, Renewo and Ferrenewo valves. W. B. Meyer was in charge.

Arrow Boiler Compound Co., St. Louis, Mo., was represented by E. M. Swindler.

Baker Valve Co., Minneapolis, Minn., displayed one of its piston valves, the merits of which were explained by C. F. Clark.

Toledo Boiler Compound Co. exhibited samples of scale which had been removed by Toledo compound, from boilers and heaters. D. Enbody represented the company.

The Perolin Co. of America occupied a booth with the Franklin Oil & Gas Co., in which demonstrations were made to show the use of Perolin as a boiler preservative, oils and graphite for lubricating purposes were displayed. H. H. Conaghan and L. A. Lux were in charge.

McLeod & Henry Co. displayed samples of steel mixture and had erected in the booth a miniature boiler setting, the excellent qualities of which were pointed out by J. A. Spencer.

Osborne Valve & Joint Co. displayed NoKut valves, for high pressure, also parts and cross sections of valves and joints, which brought out their excellent construction. W. L. Osborne was in charge.

Monarch Mfg. Co., Toledo, represented by Geo. E. Phelps, displayed a few of the sixty-nine varieties of oils and greases made by this company, some of which were Gold Medal cup grease, Semi-fluid grease, axle grease, transmission and fiber sponge grease, oil soap and Bar Belt Clinch.

Keystone Lubricating Co., with L. L. Lacey in charge, occupied a booth decorated with cans of Keystone Grease, bottles of motor oil, etc.

Toledo Belting Co. demonstrated the value of its belts, belt lacing and belt dressing. John Stalker was in charge of the booth.

Quaker City Rubber Co., represented by Theo. A. Meyers, displayed packings, valve discs, rubber hose, automobile tires and other rubber products made by this company.

GREENFIELD (MASS.) Electric Light & Power Co. has just signed a contract with the S. Morgan Smith Co. for 3 wicket type turbine water wheels for general light and power service, to be used in the re-development of the Gardner Falls Station, where 2 units already in place are to be used only in emergency after the new ones are installed.

The 2 large units will be the first concrete scroll case wheels in New England. Water is carried to the wheels through a concrete scroll in a manner similar to that developed in the big Keokuk power plant. Each of these units is a single vertical wheel direct-connected to an umbrella type generator operating at 150 r.p.m. Each wheel is rated at 1450 hp. with a 37-ft. head and is 57¼-in. in diameter. The exciter unit is vertical, of 135 hp. at 550 r.p.m., and measures 16½-in.

KNICKERBOCKER ENGINEERS

At Yonkers, June 12-15

THURSDAY was given over to the Supply Men's Association principally for the arrangement of their exhibits. Delegates and visitors alike agreed that the display was the best of any year in point of system, of arrangement, and interest, with over 80 firms and individuals represented in the exhibits. At 1:30 p.m. the exhibits were formally opened by Campbell Scott, superintendent of the Otis Elevator Works and member of the Yonkers Chamber of Commerce. The delegates did not arrive until the next day, but by evening there were many visiting engineers from Yonkers and vicinity who kept the exhibitors busy explaining the wares of their firms.

Friday

DELEGATES began to arrive in large numbers in the morning and at 11 a.m. Louis Barnard, chairman of the Local Convention Committee called the delegates together in the assembly room of the armory and introduced the Mayor of Yonkers, Hon. Jas. T. Lennon who welcomed the convention to the city.

National Vice President, Jas. R. Coe, replied to the Mayor, giving a statistical sketch of the New York State Association which showed the membership in the state to be the largest in its history, embracing over 3500 members.

Nathan M. Warren, president of the Chamber of Commerce of Yonkers, added his welcome to that of the Mayor and State President, Geo. O. Kaley, responded introducing past State President, Hubert E. Collins who spoke reminiscently on the progress of the New York State Association. He compared the present day conditions with earlier days when he attended with only 5 other delegates, and at that time only one supply man was present, and he was in town on other business.

Past National President, Edward Kearney, next addressed the convention and made the point that public speakers who welcome the delegates know little about engineers in daily life and their various organizations, hence they address the members with a few set phrases that would apply to any gathering of men and the opportunity is lost of impressing on the minds of leading men the most important characteristics of the National and State organization.

Timothy Healy, National President of the Eccentric Firemen's Union was next introduced and spoke of the better conditions of the firemen and of the unity existing between them and the engineers.

At this point the chairman turned the meeting over to the State President Kaley who appointed and instructed various committees.

At the afternoon session, the reports of the Secretary and Treasurer showed the best financial condition with a balance of close to $500 in the treasury.

The committee on license legislation reported that progress during the year had been in planning for the ensuing year and it is quite certain that results will materialize during that time. It is proposed to retain the services of an attorney to look after the interests of the Association in any future legislation.

The Educational Committee reported much work during the year, and the receipt of several good papers on live engineering topics. The rest of the session was taken up in the discussion of bettering the condition of the engineering bodies as to importance of standing in the country and the securing of better salary.

In the evening the Supply Men's exhibits were visited and at 9:30 the entertainment given by the "Bunch" began in the mess room of the armory, including songs by Joe McKenna of Jenkins Bros., monologue by Jack Armour of Power; a little magic by Mr. Martell of Peerless Rubber Co.; the Girl from Rector's by Maybell Burke; songs by Billy Murray of Jenkins Bros.; Ladies' Quartette by The Dixie Four; songs by M. J. O'Connell of N. J. Mechanical Rubber Co.

Saturday

THE meeting was called to order at 10:30 by President Kaley, and after several reports were read, the balloting for officers for the ensuing year resulted as follows: Edward E. Pruyn, Rochester, president; Frederick Felderman, N. Y. City, vice-president; Wm. Roberts, Yonkers, secretary; Wm. G. Downes, N. Y. City, treasurer; Elmer Hartley, Niagara Falls, conductor; Joseph C. Bubach, Buffalo, doorkeeper; Wm. H. Aydelotte, Niagara Falls, state deputy; Frank Connolly, Yonkers, chaplain.

The next place of convention has been left to settlement in the near future by the incoming officers. The meeting was adjourned for luncheon and the outing as guests of the Otis Elevator Co., which included a ride to and from the park situated about 2 miles out on one of the highest hills in the vicinity of Yonkers. Kinross is the name, and Campbell Scott of the Otis Company acted as an ideal host. The delegates, wives, sweethearts, and friends were entertained with vaudeville, moving pictures, Boy Scout drills, and refreshments on the grounds were served at booths by ladies and lasses, members of the St. John's Hospital.

At the evening session various papers presented by individual associations for consideration in the contest for prizes offered by the National Committee were read and discussed. At the close of the session, the retiring President was presented with a silver service.

The new officers were installed at the Sunday morning by National Vice-President, Jas. R. Coe.

Convention Notes

ON Saturday evening, the engineers of Greater New York visited the convention, every subordinate association sending its quota.

The Supply Men's Association has accomplished much in enforcing the rule, that all exhibits must be in place before the opening session of the convention or not at all.

Ed. Pruyn has rounded out 14 yr. of continuous service for the N. Y. State Association. Many of those years the Association was literally on his shoulders. It is fitting that he should have the highest honor conferred upon him at a time when everything is smooth sailing.

One of the regrets of the convention is the resignation of the official stenographer, Miss Grace Kernan, who has filled the position continuously since 1904.

The local committee of Yonkers deserve much praise for the systematic handling and arrangement of the booths. The color selections in decoration were in good taste.

Yonkers Exhibits

EXHIBITS at the Yonkers Convention were somewhat larger in number and on the whole more attractive than was the case at the convention held in the same hall last year. The weather was a bit too warm for comfort in a crowded hall, but the crowds were characteristically good tempered and everybody seemed to be having the time of his or her life.

One of the first exhibits encountered on entering the Armory was that of the Griscom-Russell Co., in charge of E. H. T. Dillon, R. S. Pickett, and David Updyke. These gentlemen distributed a souvenir memorandum book and attractive printed matter describing the Reilly Multicoil Feed-Water Heaters, Goubert Multipass Feed-Water Heaters, Reilly Multicoil Evaporators, Reilly Multiscreen Grease Extractors, Stratton Steam Separaters, Bundy Oil Separators, Goubert Hot Water Generators, Russell High-Speed Engines, Massilon Open Type Feed-Water Heaters, and Morse Garbage Destructors and Incinerators.

In addition to showing small models of some of the feed-water heaters and full size heaters in section, a working model of the Russell High-Speed Engine was shown.

Keystone Lubricating Co., of Philadelphia, occupied a double space with an attractively arranged exhibit of Keystone Greases, the colors of the cans making a pleasing contrast with the surroundings.

This exhibit was in charge of W. F. Beitler, manager, G. S. Walters and J. M. Potts.

Hewes & Phillips Iron Works occupied a position in the center of the hall so that everybody had a chance to see its exceedingly interesting, full size working model of the Franklin Releasing Valve Gear and Corliss Engine, and everybody did see it. This exhibit was in charge of Robert Phillips and A. F. Freiler.

The Philadelphia Grease Mfg. Co. showed its usual comprehensive line of Philadelphia Greases, and Richard S. Jackson, who was in charge, spoke enthusiastically of the Jackson Automatic Crank-Pin Grease Cup which he was exhibiting, also distributing literature for above products.

L. R. Merritt & Co. were showing a Coppus Turbo Blower, and distributing an unusually well prepared booklet on that product. L. R. Merritt, who was in charge, gave this blower his unqualified endorsement.

Economy Fuse Mfg. Co., of Chicago, had an interesting exhibit of Renewable Cartridge Fuses and Fuse accessories and T. Yaxley, of the New York office, explained the merits of these products.

West Disinfecting Co. made its initial bow on this occasion as an exhibitor at steam engineering conventions, showing its Liquid Soaps and Containers, Chloro-Naptholeun, Pipe Klen-Zo, Paper Towels and various disinfecting appliances. The company was ably represented by Lewis M. Chapman, assistant sales manager, who distributed liberal samples of Chloro-Naptholeun.

F. W. Webb Mfg. Co. showed "Webco" Unions, with F. B. Potterton, of the New York office, in charge.

Washburn & Granger exhibited Dean Grates for burning small grades of anthracite coal. M. J. Deegan was there with a smile all the while; also with literature describing these grates.

The C. E. Squires Co., showing Squires Steam Traps, was also the center of an interested crowd of engineers studying the working model which told the story so thoroughly that very little explanation was necessary from the men in charge, J. G. Boyer and Frank Boyle.

The William Powell Co., represented by H. Mueller Mfg. Co., made an exhibit of Union Disc and Model Star Valves; Trojan and Crescent Lubricators; Signal, Puritan and Pilgrim Oil Cups; Coin, Bruno and Progress Grease Cups. J. G. Zolleis in charge.

Clement Restein Co., represented by Al. H. Foster, of the New York office, invited attention of engineers to a complete line of Belmont Packings, for steam, water, ammonia and oil.

I. R. Nelson, representing the Allen-Bradley Electric Controlling Apparatus, distributed literature on this subject. Clarence Atkinson in charge.

The Texas Co., New York, displayed Texaco Oils and Greases, Edwin L. Holloway explaining their various uses.

Albany Lubricating Co., Adam Cooks Sons, Proprietors, made its usual extensive display of Albany Grease, Shafting and Compression Cups, Cook's Lubricant for motor car transmissions and differentials. J. W. Bluhm, in charge, contributed materially to the good nature of the crowds by distributing emblems of the "Don't Worry" and other suppositious clubs of the "cheer up" variety, cigars, pencils, etc.

Homestead Valve Mfg. Co. was represented by Frank Boyle of the New York office. Its exhibit consisted of Homestead Steam, Water, Gas and Hydraulic Valves, straight-way, 3-way, 4-way; Iron, Brass, and Acid Metal Valves, both screwed and flanged.

Dearborn Chemical Co. was there with its well-known Dearborn Treatment for Feed Water, actively and enthusiastically represented by T. H. Platt and G. H. Reilly. Everybody stopped to look at the clever cartoon of "The Little Hustler Demonstrating the Big Idea," and everybody that stopped long enough received a match box with which many of them fooled themselves before they fooled their friends.

Garlock Packing Co. made its usual display of Ring, Sheet and Spiral Packing, Pump Valves, Boiler Gaskets, Metallic Packings, and the Garlock famous "900" Sheet. This exhibit was in charge of F. S. Bulkley, who distributed lead pencils as souvenirs.

L. Sonneborn Sons, Inc., made an exhibit of Lubricating Oils, Belt Dressings, Metal Polishes, Etc., and demonstrated The New System Oil Pump, by means of a full size working model. Willis Lawrence and William J. Schatz were in charge.

Estate of Edward R. Ladew attracted a great deal of favorable attention by means of a demonstrating outfit showing Hoyt's Turtle Waterproof Leather Belting running constantly in water. Sales Manager Richard Golden, John C. Low and A. O. Rush were in charge.

H. L. Twine exhibited a general line of Mill and Factory Supplies, in charge of J. F. Taylor; the exhibit including Albany Grease, Coes Wrenches, American Split Pulleys, Ajax Valves, Eureka and Ambest Packings, Bristol's Patent Steel Belt Hooks, Dixon's Graphite Greases, etc.

Boig & Hill showed a line of Curtis Engineering Specialties, Watts Boiler Feed Regulator, Everlasting Blow-off Valves, Baum Steam and Vacuum Oil Separators. W. W. Boig and F. L. Burnham in charge.

The Fairbanks Co. showed Sphero Ball Valves; Renewable Vulcabeston Asbestos Disc Globe Valves, Brass and Iron body; Renewable seat, Brass and Iron body Gate Valves; Brass and Iron body Check Valves. L. W. Conklin explained the advantages of these various specialties.

Armstrong Cork Co., represented by Joseph Prentis and C. A. Senter, made an exhibit of Steam Pipe Insulation and Cork Insulation for Cold Storage.

The Chapman Valve Mfg. Co. occupied a double space, displaying a complete line of its Gate Valves. F. W. Sleep, Charlie Webber and R. C. Mitchell in charge.

John R. Banks found a large and interested audience for his talk about his Automatic Duplex Vacuum Return Steam Trap and Boiler Feed, a sample of which he exhibited.

Standardizing Co. occupied a liberal space in showing and demonstrating The Ernst Telescopic Disappearing Hoist, Perfection Elevator, One-Piece Checkered-Top Side-Walk Door, Cameron Portable Cranes, Betson's Plastic Fire Brick. These exhibits were in charge of Charles Schmidt and J. Schlueter.

Erie City Iron Works was represented by G. A. Hepke, who distributed literature descriptive of the Company's High-Speed, 4-Valve and Lentz Engines, Tubular Boilers, Water Tube Boilers, and Feed Water Heaters.

The Waite Co. made a display of "Flint" Blocks for Fire Box Linings, in charge of F. K. White and William J. Gravert.

The Fisher Governor Co. exhibited Fisher Governor's in section and complete; Reducing Valves, and Back Pressure Valves. Homer Whelpley, eastern sales manager, was in charge.

Skinner & Connolly occupied space in the interest of Skinner's Gage Glass Cutter and other specialties.

Greene, Tweed & Co. were represented by George R. Starrs, and made their usual attractive display of Palmetto and Manhattan Packings, and the Favorite Reversible Ratchet Wrench. Mr. Starrs also exhibited The Starrs Pump Valve.

Felber Engineering Works distributed interesting and informative literature illustrating and describing various examples of its work as contracting engineers. James O. Westberg and N. N. Rothenberg were in charge.

The Crandall Packing Co. displayed a line of Helios Packings, in charge of Harry Forward.

Peerless Rubber Mfg. Co. was there of course, showing its well-known line of Packings, Rubber Tiling, Rubber Hose, and Belting, with R. A. Sexton and W. S. Martell in charge.

Jenkins Bros. occupied a large space in a conspicuous position, showing Jenkins Bros. Valves and Packings. Frank Martin, C. B. Ohlsen, and D. E. Utz were heard to admit many times that Jenkins Bros. products are all right.

H. W. Johns-Manville Co. was on hand as usual, showing Permanite Sheet and Sea-Ring Packings, Kearsarge High Pressure Rod Packing, Man-Hole and Hand-Hole Gaskets and Pipe Covering. William McElraevy and H. T. Lyman were in charge.

Thread-Tight Co. made actual demonstration of its product, a compound for making tight joints under high pressure, steam, ammonia, air, etc. An interesting feature of this exhibit was a gasket made of ordinary wrapping paper covered with Thread-Tight. Mr. Ehrmann of the company conducted the demonstrations.

J. O'Meara, Inc., showed a line of Valves, Valve Discs, etc.

John R. Robinson, who represented Bayer Steam Soot Blower Co., of St. Louis, for which he is district sales agent, also presented a line of Power Plant Specialties, including the Detectorphone, otherwise known as the "Mechanical Stethoscope," an electrical instrument for detecting internal troubles of machinery. Mr. Robinson was assisted by C. H. Rugg.

Broderick & Bascom Rope Co. made an exhibit of Special Elevator Rope, in charge of C. Arthur Dunlavy, Mgr. N. Y. office., J. R. Bohn and John O. Tepper.

Joseph C. Ryan took space to advertise his business as Engineer, Contractor and Dealer in Mill Supplies.

New York Belting and Packing Co., represented by E. J. Flynn, F. N. Anderson and Daniel Allen, showed its well-known lines of Indestructible, Firo and Ruby Sheet Packings, Cobbs, Graphon, Vulcan, Flax and Hydraulic Packings, Pump Valves and Asbestos Gaskets.

J. L. Quimby & Co. extended a cordial greeting to engineers through their representatives, John J. McDonald and Ralph N. Hand, who made a particularly attractive presentation of its line of Oils, Greases, Boiler Compounds, Elevator Emulsion, Soap Powder, Automobile Oils, Pipe Cleaner and Disinfectant. Callers were presented with a leather covered match holder, and the cigars were quite handy.

S. F. Bowser & Co., Inc., in addition to demonstrating the Bowser Filters by means of a working model, conducted a guessing contest, with a prize of a Starrett Engine Level, to the engineer guessing nearest the flow per hour through 5 feeds. H. E. Dobson and G. B. Kamps were in charge.

Eddy Valve Co. had a display of Eddy Valves and Fire Hydrants, in charge of Harry A. Holmes.

Russell, Burdsall and Ward made an exhibit of Bolts and Nuts made from Open Hearth Steel.

The Lagonda Manufacturing Co. was represented by M. O. Lewis, who displayed in a prominently located booth the Weinland tube cleaners, Strainers and Valves. On Flag Day, the 14th, small American flags were distributed and were so commonly accepted and worn as to change the whole color scheme of the crowds in attendance.

C. T. Coe Co. exhibited various types of Coe shaking and dumping grates. C. T. Coe and Frank C. Coe were in charge.

The United States Graphite Co. made an interesting display of its Mexican boiler graphite, and a line of graphite greases, distributing as souvenirs quarter pound cans of its No. 205 Powdered Lubricating Graphite. W. G. Seeley in charge.

Home Rubber Co., represented by E. A. Schatz, showed a line of N. B. O. packings.

York Manufacturing Co. was represented by Shipley Construction and Supply Co., and, in addition to making a display of ammonia valves and fittings, distributed literature descriptive of practically everything pertaining to ice machines. Tom Oakes was in charge.

W. M. Bastable Co. made an interesting display of Hays Differential Draft Gages, Hays Improved Gas Analyzer, Thwing Recording Pyrometer and Electric Tachometers. S. H. Page was in charge.

The Grieve Grate Co. showed a line of Grieve Patent Grates; in charge of C. M. Watson and R. H. King.

Power was represented by N. C. Robbins and Jack Armour.

Ingram Wheel Co. dispayed the Ingram Wheel and Rubberless Tire for automobiles.

American Engine Co. was represented by Harry J. Marks, who distributed literature descriptive of American-Ball Angle Compound Engines.

United Metal Hose Co., Inc., had an exhibit of flexible metal hose of interlocking construction, in charge of E. L. Heilprin.

(Continued on page 670)

Power Apparatus in Shop and Market

New Ideas In Making, Buying and Selling

RECORDING DIFFERENTIAL PRESSURE GAGE

Bristol's New Float Type

THIS new float type differential recorder has been tested under practical operating conditions in steel works. It was developed to meet requirements for which the spring pressure types of differential recorders are not suitable, that is for very low ranges of differential pressure in air, gases, liquids or steam, for applications where the static and differential pressures fluctuate rapidly, and also to satisfy the demand for instruments to record the rate of flow or volume directly on charts having uniform graduations in units of flow or volume.

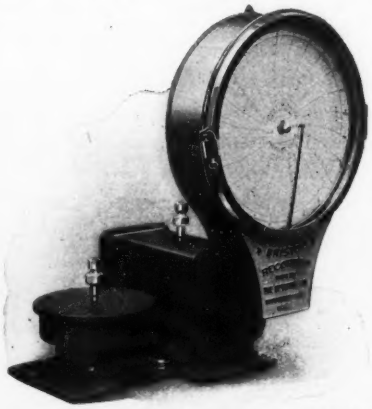


FIG. 1. BRISTOL'S FLOAT TYPE RECORDING DIFFERENTIAL PRESSURE GAGE

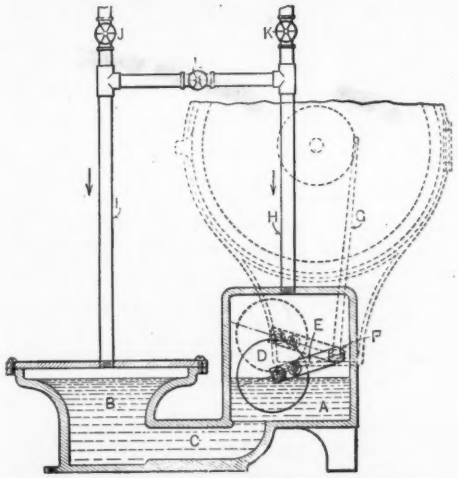


FIG. 2. SECTION OF BRISTOL'S RECORDING DIFFERENTIAL PRESSURE GAGE

The construction and principle of operation of the instrument will be readily understood by referring to the sectional diagram Fig. 2. There are 2 pressure chambers, A and B, intercommunicating through the connection C. A cylindrical float D is located in the pressure casing A as indicated, and is connected by arms to the shaft F, which extends through the casing. The recording arm C is directly connected to the end of the shaft F.

Connections are made by means of the pipes H and I between the pressure chambers A and B and the 2 pressures whose difference it is required to record. Mercury or water is employed in the pressure chambers according as the differential range to be recorded is high or low. When the higher pressure is applied to the chamber B through the pipe I, the level of the liquid in this chamber is lowered and that in the float chamber is raised, carrying the float and the attached recorder arm with it and making a record on a circular chart as it is revolved by a special clock at the desired speed.

By making the cross sections of the pressure chamber B of certain proportions as indicated, it is possible to produce a scale whose graduations are uniform for equal increments of flow or volume. The Bristol-Durand radii averaging instrument can there-

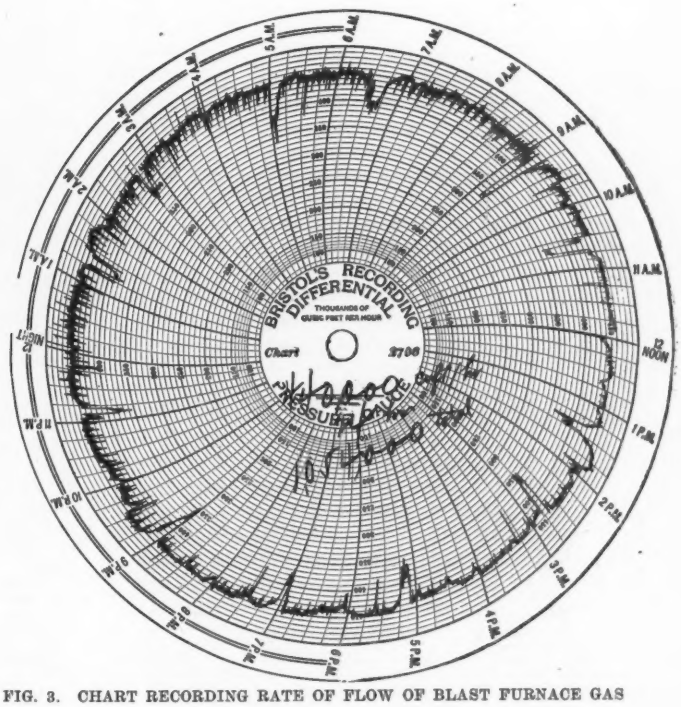


FIG. 3. CHART RECORDING RATE OF FLOW OF BLAST FURNACE GAS

fore be used to obtain total flow or volume from the chart record of this instrument for a period of 24 hr.

As these gages will operate on extremely low differential ranges they are particularly well adapted for use in connection with Pitot tubes for recording volumes of liquids, air or gases.

Figure 3 is a reduced reproduction of a 24-hr. record of the flow of blast furnace gas, made by one of these instruments in connection with Pitot tubes, in one of the largest blast furnaces in the United States. It will be noted that this chart is graduated in thousands of cubic feet of gas per hour, the range being from 0 to 500,000 cubic feet per hour. The working part of the chart above 150,000 is provided with uniform volume graduations. The actual differential pressure for the total range of the chart shown was 0 to 1.46 in. head of water. From this it will be seen that with a simple inexpensive Pitot tube it is possible to obtain sufficient differential pressures at slow rates of flow to record directly the amount and variations of the volume.

This instrument may be used to record the head of water in tanks under varying pressures, as for instance height of water in steam boilers and condensers. Another special application is that of recording the flow of water through a notch or over a wier, even though liquid is under pressure or a vacuum.

This instrument is the product of Bristol Company, Waterbury, Conn.

STARRETT RATCHET WRENCH FOR ENGINEERS

THE difficulty of setting up or slacking off nuts in cramped places is removed with the ratchet wrench, perfected by the L. S. Starrett Co., of Athol, Mass. The slowness of the ordinary monkey-wrench, due to frequent and necessary removals from the screw or nut, especially when only short turns can be made, is a disadvantage second only to the liability of injury to the knuckles of the man using the tool.

STARRETT RATCHET WRENCH AND ACCESSORIES

The Starrett patent ratchet wrench overcomes these objections and still further includes some features not looked for in a wrench, namely: the drilling fixture and the screw-driver attachment. This tool is designed to turn a nut rapidly in either direction without removing the wrench from start to finish. With it can be used any one of a large number of interchangeable steel sockets varying by 1/32 in. and having a range from 5/16 to 1¼ in. These sizes take care of practically every ordinary bolt and nut.

A universal joint attachment for use in particularly awkward places is appreciated by those who have had experience with ordinary wrenches, and an extension which will take any of the sockets permits turning in places otherwise inaccessible. The wrench may also be used as a screw-driver, for it is provided with a screw-driver attachment with reversible blades of 2 sizes.

In addition to these attachments a first-class drilling fixture fits the rachet head and will hold any size of twist drill from ⅛ to ½ in. Difficult drilling can then be done as easily as in ordinary places, the feeding being done with a special friction wrench supplied with each tool. The accompanying illustration shows this wrench with all accessories packed in a neat box, making one of the most useful and convenient sets any automobilist or engineer can have.

(Continued from page 668)

McLeod & Henry Co. made its usual display of "Steel Mixture" for boiler door arches, and special tongue and groove inserted arches; in charge of a veteran "conventioneer," John H. Foote, who distributed souvenirs in the way of folding metal drinking cups.

The Lunkenheimer Co. made a liberal showing of Lunkenheimer valves and engineering specialties; in charge of W. A. Reynolds, A. S. Philipps and Frank Hyatt.

I. Schonberg, represented by T. S. Ferguson, exhibited M. & M. White Bronze and Babbitt metals.

Otis Elevator Co. had an exhibit which attracted unusual attention. It was a full size demonstration outfit, showing an Otis electric elevator controller in operation. Another interesting feature of this exhibit was repair parts put up in handy cabinets of various sizes. W. J. Keenon, in charge, distributed literature descriptive of Otis gravity, spiral conveyors, elevator lubricants, etc.

Grenpoint Fire Brick Co., represented by E. DeVoe, distributed literature descriptive of the Company's fire bricks for all purposes.

Diamond Power Specialty Co. presented the "Diamond" Soot Blowers, displaying small models showing installations on various makes of boilers. W. Schlueter and S. L. Van Ameringue in charge.

The V. D. Anderson Co. exhibited Anderson Steam Traps, Floats, Oil Filters, Steam Separators, Water Columns, Air Traps, etc. L. A. Couch was in charge, assisted by L. H. Rumages, of Buffalo.

The Wickes Boiler Co. showed a model boiler demonstrating the water circulation. James Milne and E. F. Baker in charge.

National Engineer was represented by C. F. Ceilley.

The Pitts & Kitts Mfg. & Supply Co. exhibited Everlasting Blowoff Valves, Northern Specialty Water Glass fittings, Boyd turbine pump valve, Kitts Mfg. Co.'s line of steam specialties, Perolin German Boiler Metal Treatment, Zinco Soot Destroyer, McKim Gaskets and McLeod Lubricators. Those in charge were W. A. Kitts, Jr., Wm. S. Pitts, Wm. J. Tighe, and J. R. Hughes.

W. B. McVicker Co. showed high grade lubricants, scientific boiler compounds, hydraulic elevator compounds, soap powders, disinfectants, etc. Jos. Engasser, A. T. Camden, W. B. McVicker and Jos. Hammil were in charge.

The Danubil Co., showing Danubil sheet packings for high pressure and superheated steam, in charge of G. G. Schick, G. M. Norman, L. Read and James R. DuBois.

Harrison Safety Boiler Works exhibited the usual line of Cochrane specialties, in charge of Charles Willard.

M. T. Davidson Co. distributed literature descriptive of its pumps and condensers. John Lowe in charge.

Southern Engineer was respresented by Lewis L. Warren and Fred Dobie.

Buhne Metal Packing Co. showed the Buhne Metal Packing which has become widely known among engineers as "Shredded Wheat." C. L. Johnson in charge.

Ashton Valve Co. made an exhibit of Ashton Steam Specialties, in charge of C. W. Ulrick.

Hazard Manufacturing Co., represented by George Wicks, showed Wire Rope, Insulated Wire Rope and Swedish Iron Electric Cable.

John A. Roebling Sons Co. presented its lines of Wire Rope and Cables, through John W. Troescher, in charge.

The Chamber of Commerce of Yonkers occupied a booth as an information bureau for the delegates. It was in charge of John P. Radcliff, Secretary, and Chester J. Schlisman, Asst. Secretary.

Practical Engineer was represented by H. E. Collins and John A. Kershaw.

IN A BOOKLET just published by the Joseph Dixon Crucible Co., Jersey City, N. J., entitled "Dixon's Graphite Brushes," the qualities of these brushes, such as preventing of sparking and wearing of the commutator, avoidance of gumming on the commutator and reduction of friction, are fully explained, and the rules given for using the brushes under various conditions. There is also a discussion of graphite resistance rods and lubricating rods.

"A NEW PAPER MILL ENGINE" is the title of a 16-page pamphlet, size 6 by 9 in., recently issued by the American Engine Co., Bound Brook, N. J. Besides describing and illustrating the American-Ball 4-cylinder paper mill engine, drawings are shown of the 20-cylinder angle type variable speed engine, also of the 2-cylinder horizontal variable speed paper mill engine.

NEWS NOTES

DEARBORN CHEMICAL Co. announces its removal, July 1, from 332 S. Michigan Ave., Chicago, to the 20th floor of the new Union Central Building.

NORTHERN EQUIPMENT Co. has removed from 408-418 West Indiana St., Chicago, to 111 West 11th St., Erie, Pa.

WORK ON THE NEW electric light plant for the F. Schenk and Son's company at Fulton, W. Va., is progressing nicely. As soon as the old buildings are removed the work of excavating will be started.

ROYALTON, PA., HAS VOTED to build its own electric light plant, since other companies could not bid on the work to suit the councilmen. A system of tungsten electric lights will be installed.

ELECTRIC LIGHT & POWER Co. of Montevideo, Minn., intends to erect a new building, costing about $40,000, on the present site. Work will commence as soon as the contract can be let.

CONTRACTORS ARE ESTIMATING UPON the power house for the municipal lighting plant to be erected and operated by Camden, N. J. The building, which will cost $100,000, will measure 80 by 80 ft., be 3 stories high, and be constructed of brick and concrete.

IT IS STATED THAT Winston-Salem, N. C., is to have as good electrical service as any city in the entire South, since the Fries Mfg. and Power Co. is now engaged in installing a new plant at the Yadkin River power plant that will cost in the aggregate about $75,000.

CLARKSBURG, W. VA., will have the best electric light and power plant in West Virginia when the work is completed. The equipment will be of the most modern type, and the capacity will be much greater than the present demands which are now very heavy.

THE SARCO ENGINEERING Co., New York, will open a new office in Chicago, July 1, to take care of its largely increased business in the middle West. Ample stock of the Sarco steam traps will be carried to meet all requirements. George H. Burke, for several years Sales Manager at the New York office, will be in charge.

KALAMAZOO, MICH. will begin the construction of a new municipal lighting plant within the next few days. When completed it will be one of the largest in the state and will be capable of furnishing ample current for all street lights, as well as a surplus which can be used for other purposes.

H. L. WATSON, Member American Society of Mechanical Engineers, formerly Sales Engineer with the Allis-Chalmers Mfg. Co., of Milwaukee, has accepted the position of Sales Manager for the De Laval Steam Turbine Co., of Trenton, N. J., manufacturer of steam turbines of the single-stage, velocity-stage and pressure-stage type, also of centrifugal pumps, speed reduction gears, turbine blowers and other apparatus of an allied nature.

THE READING RAILWAY has awarded the contract for erection of a power house at Yardley, Pa. It will be located west of Yardley station and will be built of concrete and brick, with slag roof, supported on concrete foundations, with concrete coal pocket. The pump house, located east of Yardley station on the west bank of the Delaware River, will be a reinforced concrete structure, with asbestos shingle roof and concrete steps and platform.

PLANS HAVE BEEN PREPARED by the Pittsburgh Railways Co. for trebling the capacity of the plant on Brunots Island. The capacity will be increased from 25,000 to 85,000 kw. Bids are now being taken for the increased 60,000 kw. Twenty Stirling boilers of 822-hp. capacity each have been ordered from the Babcock & Wilcox Co. and the Westinghouse Co. will supply 4 15,000-kw. turbo generator sets. Condensers and pumps will be furnished by the Worthington Pump Co. The boilers are to be placed in 4 batteries of 5 boilers each. A 14 by 180-ft. stack will be furnished for each battery. Estimates on the stoker equipment have already been taken.

AT THE RECENT MEETING of the National Electric Light Association, the following officers were elected for the coming year: President, J. B. McCall, of Philadelphia; First Vice-President, John A. Britton of San Francisco; Second Vice-President, Holton H. Scott of New York; Third Vice-President, E. N. Lloyd of Chicago; Fourth Vice-President, E. C. Beal of Augusta, Ga.; Treasurer, W. F. Wells of Brooklyn, N. Y.; Secretary, T. Commerford Martin of New York. The Doherty Gold Medal for the most valuable paper was awarded to T. F. Bloodworth of New York. The Billings Silver Medal went to Fred Willoughby of Denver, and A. D. Bailey of Chicago was given the award for the third best paper.

OLIVER W. HULL, formerly associated with the Hitchcock Publications of Chicago, as western advertising manager, has joined the Chamberlin Co., Technical Publicity, of Detroit. Mr. Hull is well and favorably known in machinery circles throughout the middle west. His wide knowledge of manufacturing and selling problems in the field in which the Chamberlin Co. is engaged will undoubtedly prove a valuable acquisition to this large and rapidly growing organization. The Chamberlin Co. has always done business on a fee basis, believing that the agency should receive its compensation from the client and not from the publisher, as is the rule with general advertising agencies. The fact that the Company has not lost an account since its organization is a tribute to the high character of its service.

UNITED STATES CIVIL SERVICE COMMISSION announces an open competitive examination for inspector of motive power, for men only, on July 23, 1913, at principal cities of the country. From the register of eligibles resulting from this examination certification will be made to fill vacancies as they may occur in this position in the Interstate Commerce Commission, under the act providing for the valuation of the property of common carriers, at salaries ranging from $1200 to $1500 per annum. Not less than 3 years' experience in the motive power department of a railroad or with locomotive works is required for admission to this examination. Graduation in mechanical engineering from a technical school of recognized standing will be accepted in lieu of 2 yr. of these 3. Applicants must have reached their 25th, but not their 60th, birthday on the date of the examination. Persons who meet the requirements and desire this examination should at once apply to the United States Civil Service Commission, Washington, D. C., or to the secretary of the board of examiners at principal cities for Form 2039. In applying for this examination the exact title, Inspector of Motive Power (male), should be used.

CATALOG NOTES

ARGUTO OILLESS BEARINGS, made of wood which has been chemically treated, are described and illustrated in a pamphlet from Arguto Oilless Bearing Co., Wayne Junction, Philadelphia, Pa.

JENKINS BROS. brass gate valves with outside screw and yoke, in 3 patterns—standard, medium and extra heavy, are illustrated and a table of dimensions is given in a folder from Jenkins Bros., 80 White St., New York.

THE LABOR SAVER, No. 58, recently received from Stevens-Adamson Mfg. Co., Aurora, Ill., shows various methods of reducing production costs by mechanical appliances adapted for handling material in bulk or package. This publication is issued monthly and copies may be obtained by addressing the company as above.

MAZDA STREET-RAILWAY lamps are described in Bulletin 18A, which supersedes Bulletin 18 and gives general information and technical data on the performance and characteristics of these lamps. A list is given of other new bulletins available by addressing the Engineering Department of the National Electric Lamp Association, 4411 Hough Ave., Cleveland, O.

BRISTOL'S RECORDING THERMOMETERS, for temperatures between 60 deg. below zero and 800 deg. F., are described in a 48-page catalog, No. 1300, containing charts and other illustrations.

New bulletins, Nos. 143 and 173, on Bristol recording differential pressure gages, and Bulletin 170 on soldering iron electric furnaces have also been issued by the Bristol Company, Waterbury, Conn.

THE GENERAL ELECTRIC CO. has just issued Bulletin No. A-4109, on the subject of belt-driven revolving armature alternators, which supersedes the company's previous bulletin on this subject. The alternators described are of 3 sizes: 7½, 15, and 25 kw.

Bulletin No. A-4122, from the same company, is devoted to carrier bus arc panels and brush arc generators. This bulletin supersedes the previous bulletin on this subject.

THE WESTINGHOUSE Electric & Mfg. Co. has issued descriptive leaflet No. 3679 covering Electric Vehicle Battery-Charging Switchboards and Motor Generator Sets. These devices are described and illustrated in detail. Special mention is made of the sectional switchboard which has proven very satisfactory for this class of work enabling additions to be made from time to time with slight expense.

Folder 4255 describes Westinghouse Type P G porcelain insulators. These are insulators with high mechanical strength suitable for use on 1500-volt d.c. railway work and 2300-volt transmission lines.

"HIGH VACUUM SURFACE CONDENSERS" is the title of Bulletin 106-A, recently issued by the Wheeler Condenser & Eng. Co., of Carteret, N. J. This bulletin takes up such subjects as the effect of condensing on steam engine and steam turbine economy; the choice of a kind of condenser; the design of high vacuum surface condensers; the influence of steam distribution; the effects of flooding on condenser surface, and explains the advantages of the Wheeler dry tube condenser. Copies may be had on application to the Wheeler Condenser & Engineering Co., Carteret, New Jersey.

PRACTICAL ENGINEER

Trade-mark reg. U. S. Pat. Office.

SEMI-MONTHLY

PUBLISHED ON THE FIRST AND FIFTEENTH OF EACH MONTH

Subscription price in advance in the United States, Mexico or united possessions, $1.00 a year.
In Canada, subscription price $1.75 a year.
Foreign Countries, subscription price $2.50 a year.

Address all letters and make all checks and money orders payable to Technical Publishing Co., 537 S. Dearborn St., Chicago, Ill.

Any advertiser is invited to examine our paid subscription lists and Post Office mailing receipts at any time.

ADVERTISING RATES

Display

Full page, one year, each insertion, $60.00.
Half page, one year, each insertion, $35.00.
Quarter page, one year, each insertion, $20.00.
Eighth page, one year, each insertion, $12.00.
Front cover, $150.00 per issue.

Other specified positions, regular rate plus 10 to 50 per cent.

Stippled plates used but no heavy black and white plates.

Invoices are rendered monthly and subject to 2 per cent discount within 10 days.

Classified Rates

Per line, 30 cents each insertion.

Advertisements in this section are inserted under regular headings.

No display type allowed, but the first three words may be set in capital letters.

About nine words make a line. Minimum space sold, two lines.

Under classification "Position Wanted," advertisements not exceeding four lines will be inserted once for subscribers free of charge.

All copy should be received at Chicago office 18 days before date of publication.

Circulation of this issue, 22,500

Technical Publishing Co.
537 S. Dearborn Street
Chicago

Positions Wanted

POSITION WANTED—By first-class Steam Engineer. A. and D. current. Can give results and best of reference. Sober and steady, 14 yrs.' experience. Address Box 309, Practical Engineer, Chicago, Ill. 7-1-1

POSITION WANTED—As Manager or Superintendent of an electric light or ice plant. I am a practical engineer and know the electric light and ice business thoroughly. As to my character and ability, I can furnish you all the references you wish. I am at the present employed as chief engineer of an Electric, Light and Ice plant. Address B. E. C., 2004 Alston Ave., Ft. Worth, Tex. 7-1-1

POSITION WANTED—As an Assistant Engineer or an oiler. In or near Chicago. I have 6 yrs. practical experience in handling pumps or boilers; also 3 yrs. experience in steam fitting and all kind of repair work. At present I am in a 500 H. P. plant as an assistant. I have a city water tender license. I am married, age 25 yrs. Would prefer a place where I could advance myself. Address Joseph P. Sepp, 3418 Le Moyne St., Chicago, Phone, Belmont 5378. 7-1-1

POSITION WANTED—As Engineer in small plant, or assistant in a large plant, by man of 28 yrs. No bad habits, 3 yrs. machinist experience; understands A. & D. current; holds local engineer's license. C. H. Freeman, 57 North St., Elgin, Ill. 7-1-1

POSITION WANTED—Young married man with technical education. Mechanical draftsman. Practical experience with oil engines and ice machinery. At present engineer in small ice plant. Desire position after November 1st. Best of references. Permanent position wanted with offer of promotion for the man who makes good. J. B. Walker, Savannah, Tenn. 7-1-1

POSITION WANTED—As Electrical Engineer; at present in charge of large electrical plant in New York. 12 years technical and practical experience. Strictly sober and industrious. Address William MacInally, Pleasantville, N. Y. 7-1-1

Wanted

WANTED—One 350- to 400-hp. high-pressure boiler. Address Wausau Box & Lumber Co., Wausau, Wis. 7-1-2

WANTED—ALL STEAM USERS to have clean boilers without using compounds or chemicals in any form. Write "Otis," No. 317 Norfolk Ave., Buffalo, N. Y. tf.

IF YOU ARE a night engineer, spend a few hours each day taking subscriptions for Practical Engineer. You will be paid well. Write Subscription Dept. They will start you in at once.

WANTED EVERY ENGINEER to have our pamphlet for setting valves on Corliss Engines, simple and compound, with one or two eccentrics. Sent free. Lindstrom's Machine Works, 200 South Third St., Allentown, Pa. tf.

Help Wanted

WANTED SALESMAN—The Marion Machine, Foundry & Supply Co., of Marion, Ind., have a new catalogue on the press, describing a most complete line of Boiler Room Specialties and are desirous of securing some good strong agencies to represent their line. Address P. O. Box 400, Marion Machine, Foundry & Supply Co., Marion, Indiana. 7-1-1

WANTED—An additional subscription solicitor wanted to cover towns in the state of Washington. Excellent chance to earn extra money. Write to Subscription Department. tf.

For Sale

FOR SALE—Transformers rewound, repaired, rebuilt, built to order; also new and used transformers for sale; prices very reasonable; hundreds of our make are now in operation on the Pacific Coast with voltages ranging from 10 to 80,000. Western Transformer Co., 4th Ave., 18th St., Oakland, California. 7-1-1

FOR SALE—One 10″x16″ Ideal tandem compound center crank steam engine, 100 i.h.p. at 270 r.p.m. High pressure cylinder has piston valve, low pressure cylinder, balanced slide valve, operated from inertia type shaft governor. Fly wheel 5′ 8″, 15″ face. Steam pipe 4″, Exhaust 5″, shaft 5½″, over-all dimensions 5′x11′7″.

One 10″x9″ simple Junior Westinghouse engine; capacity 50 i.h.p. at 335 r.p.m.; fly-wheel 3′ 6″ diameter, no belt wheel; steam pipe 3½″, exhaust 4″; shaft 3⅜″; over-all dimensions 3′ 8″x7′ 2″. For further information concerning these engines address James M. White, Supervising Architect, University of Illinois, Urbana, Ill. 6-15-3

FOR SALE—Cost Sheet, giving cost of fuel for oil, gas and steam engines and current for electric motors; at all prices and rates of consumption; folding pocket size, 10c, stamps or coin. A. Stritmatter, 213 E. 7th, Cincinnati. 7-1-2

FOR SALE—One Bristol Recording thermometer with 25 ft. of flexible tubing. One Edwards Pyrometer, 0 to 1200 degrees. One calorimeter complete with nozzles in polished case. Write to-day. Taylor, 85 S. Monroe St., Battle Creek, Mich. 6-15-3

Patents and Patent Attorneys

THE PATENTOME is interesting and instructive. A liberal education in patents and how to get them. Free on request. Established 1865. Anderson and Son, Patent Solicitors, 710 G St., Washington, D. C. 7-1-2

PATENTABLE IDEAS WANTED—Send for 3 free books. R. B. Owens, 28 Owens Bldg., Washington, D. C.

FIND OUT FOR YOURSELF what to invent and how to procure and sell a patent for the same. My book, "Inventor's Universal Educator," covers the matter from A to Z. 140 pages, elegantly bound. Also contains 600 mechanical movements and 50 perpetual motions. Price $1.00, postage free. Money returned if not more than satisfactory. F. G. Dieterich, 618 Ouray Bldg., Washington, D. C. 7-1-1

PATENTS SECURED—Send sketch or model for search. Book containing over 200 mechanical movements, advice and search free. W. N. Roach, Jr., 515 Metzerott Building, Washington, D. C. 5-15-7

PATENTS THAT PROTECT AND PAY. Advice and books free. Highest references. Best results. Promptness assured. Send sketch or model for free search. Watson E. Coleman, Patent Lawyer, 624 F Street, Washington, D. C. tf.

PATENTS—H. W. T. Jenner, Patent Attorney and Mechanical Expert, 606 F St., Washington, D. C. Established, 1883. I make a free examination and report if a patent can be had and the exact cost. Send for full information. tf.

PATENTS—C. L. Parker, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. 186 McGill Building, Washington, D. C. tf.

Educational and Instruction

ELECTRICITY—JUST WHAT YOU HAVE been looking for. Our Modern Blue Print Chart Method of Electrical Wiring Diagrams. Thoroughly explained so that you can easily understand them. All kinds of Bell Wiring, Anunciators, Telephones, House Wiring, Conduit, Theatre, Isolated Plants, Dynamos, Transformers, Arc Lights, Special Treatise on Motor Wiring. Write now for information. Electrical Wiring Diagram Co., Box F. 173, Altoona, Pa. 6-1-6

ENGINEERS' POCKET MANUAL. 175 pages, edited by University of Tennessee, will be mailed every subscriber sending in one new subscription to Practical Engineer. Gild edges, bound in leather. tf.

Miscellaneous

IF YOU ARE an operating engineer, we know the Fetta Hot Process Water Purifier will interest you. We would be glad to have your request for further information. Address the Fetta Water Softener Co., Richmond, Ind. tf.

ENGINEERS—DO YOU WANT to utilize your exhaust steam for heating or drying purposes, without back pressure on your engine? If so, address Monash-Younker Co., 1413 W. Jackson Blvd., Chicago, Ill. tf.

MAKE MONEY on the side. Here's your chance to work out some money for yourself. Get subscriptions for Practical Engineer. It pays well. Just drop a line to the Subscription Dept. They will tell you. tf.

Sparks From The Advertising Pages

Next Friday, mid the booms of cannon and anvil salutes, the residents of our thousands of small cities and towns will awaken to a day of noise, picnics and family reunions.

Millions of metropolitan toilers will laugh at the alarm clock, others will deluge the golf fields and ball parks, or with rod and reel hie themselves to cool, watery retreats.

Children will cry for firecrackers or cry at them for the burns they may receive. Young lawyers, on bunting draped stands of new lumber, will oratorically weave the American Eagle and the Stars and Stripes into a sentimental support for their future political ambitions. And, out of the blackness of night, fiery images of Washington, and Lincoln and Jefferson, will ignite a blaze of Patriotism.

It's July Fourth—the anniversary of our country's freedom.

When the representatives of the 13 colonies met in Independence Hall, Philadelphia, in 1776, and drafted the Declaration of Independence, they *did more* than remove the *Oppression of Taxation without Representation.*

They wrote the first advertisement of freedom of *speech,* freedom of *press,* freedom of *religious thought* and freedom of *opportunity.* They wrote an advertisement that never has been equalled for *pulling power,* and one which is pulling better today in its one hundred and thirty-seventh year than ever before.

It draws to America from *all corners* of the Earth. Slav, Teuton, Gaul, Celt, Anglo-Saxon, Scot, Scandinavian and Jew—breaking home ties —venturing with the spirit of a Crusader or a Columbus—*come* to make their home in the country that advertises that "all men are created free and equal."

And, back of the advertisement, the country *delivers.* The story of the lives of such men as Carl Schurz, Andrew Carnegie, John A. Johnson, Isador Straus, and Charles Louis Bonaparte (Napoleon III) indelibly records that the Statue of Liberty is a *personification* of the spirit of the land over which she watches.

Advertising is the Statue of Liberty of Business. It stands for Freedom from *Monopoly* and *Fraud.*

The advertising pages of Practical Engineer are open to all of *reliability.* Through them, you can choose from the different manufacturers. Through them, the manufacturer can talk to thousands of engineers. *But, there was a time, before the growth of advertising, when it was considered unethical for a firm in one city to try to sell to buyers in another city.* Then, the buyer paid more and the manufacturer profited less.

It is through advertising that power plant engineers are freed from the *lack of knowledge.* It breaks the chains of *Antiquity.*

Last week, Practical Engineer received a letter from an engineer in India asking for information about certain products advertised in its pages. This engineer, living in a country not given to the manufacture of machinery, is in close touch with the manufacturers catering to Power needs. Advertising is not limited by *distance* or *days.*

More than this, modern advertisements are a *tabloid education* in themselves. They state facts without burying them under a *mass of theory.* It pays to read them all thoroughly.